DEC 4 1912

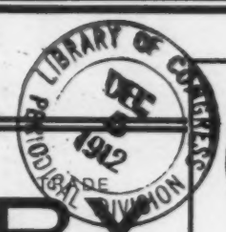
JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXIX NO. 22 — SAN FRANCISCO, NOVEMBER 30, 1912 — PER COPY, 25 CENTS



TRADE BX MARK **FLEXIBLE STEEL ARMORED CABLE** BX MARK

A Coil of Greenfield Flexible Steel Armored Conductors

THE great flexibility and mechanical strength of BX Cable makes it extremely easy to handle and certain to give satisfaction. Fire hazard is greatly reduced, for chafed and crossed wires are unknown. BX easily meets all New Code requirements and is approved by the Underwriters' Laboratories Inc. and Municipal Boards.

Ask for a Copy of Catalog No. 43654

SPRAGUE ELECTRIC WORKS

OF GENERAL ELECTRIC COMPANY

MAIN OFFICE

527-531 West 34th St., New York, N. Y.

San Francisco, Rialto Bldg. Seattle, Colman Bldg.

Where to Buy It in the West, Pages 9, 10. Alphabetical Index to Advertisers, Page 8.

DEC 4 1912

Glass Insulators

ACME OF QUALITY

The Sand obtained near Riverside, California, is over 90 per cent silica—remarkable freeness from iron.

The Lime used is found almost free from foreign matter.

The Soda is practically pure—

To preserve this purity and quality.

Every grain of sand, every piece of lime, every shovelful of soda is sacked for shipment and stored under cover at the factory.

Every ingredient used is automatically weighed by most carefully adjusted scales to insure absolute accurate proportions.

Every bit of material is thoroughly mixed by human hand.

Every ounce of glass is moulded and annealed by the latest improved process under most favorable conditions, reducing possibility of defects to a minimum.

Every insulator is seasoned for three months in the open; individually inspected before packing and shipment.

Favored by Nature to start with; made with extreme care and precision, this is why

California Glass Insulators

have QUALITY

For further details and prices, address

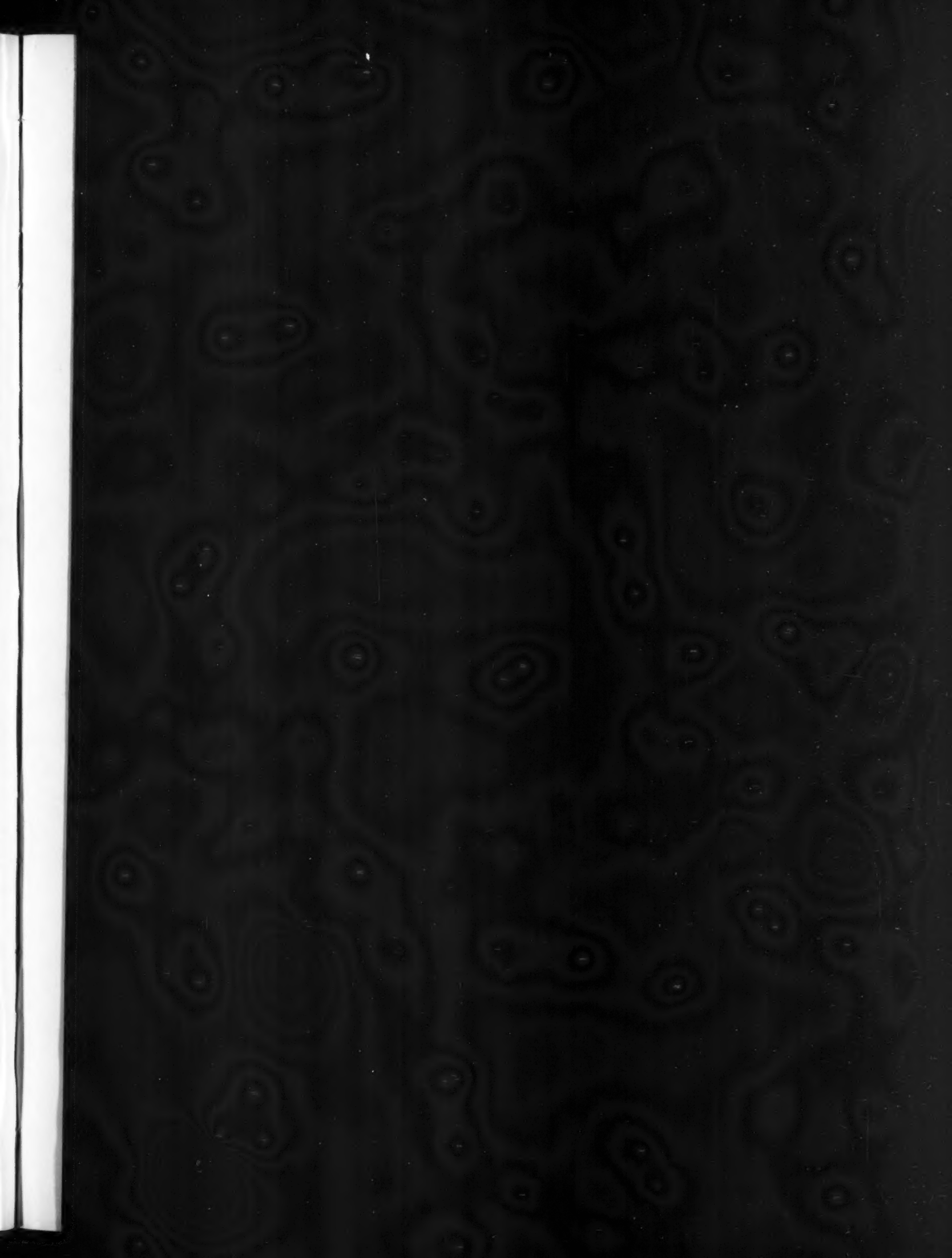
PACIFIC STATES ELECTRIC CO.

The Modern Electrical Supply House

Distributors for the Pacific Coast

SAN FRANCISCO OAKLAND LOS ANGELES PORTLAND SEATTLE

PACIFIC STATES ELECTRIC CO. **SERVES THE PACIFIC COAST**

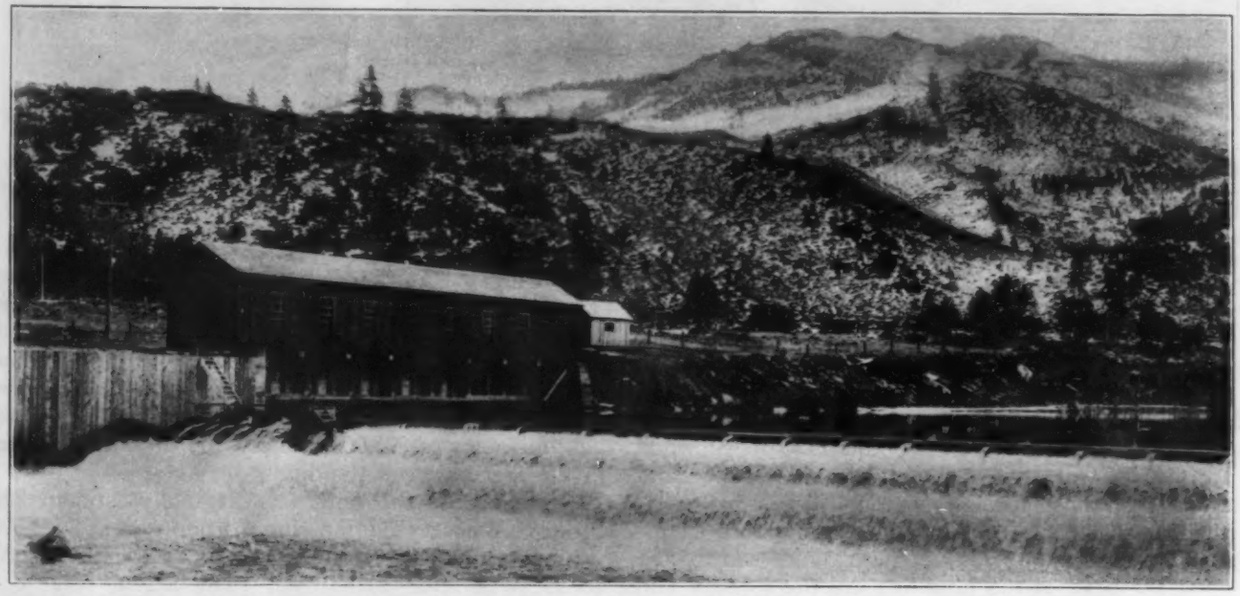


B27 3 302

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIX SAN FRANCISCO, NOVEMBER 30, 1912 NUMBER 22

[COPYRIGHT 1912 BY TECHNICAL PUBLISHING COMPANY]



Diversion Dam and Headgates, Verdi Station

HYDROELECTRIC DEVELOPMENT AT VERDI

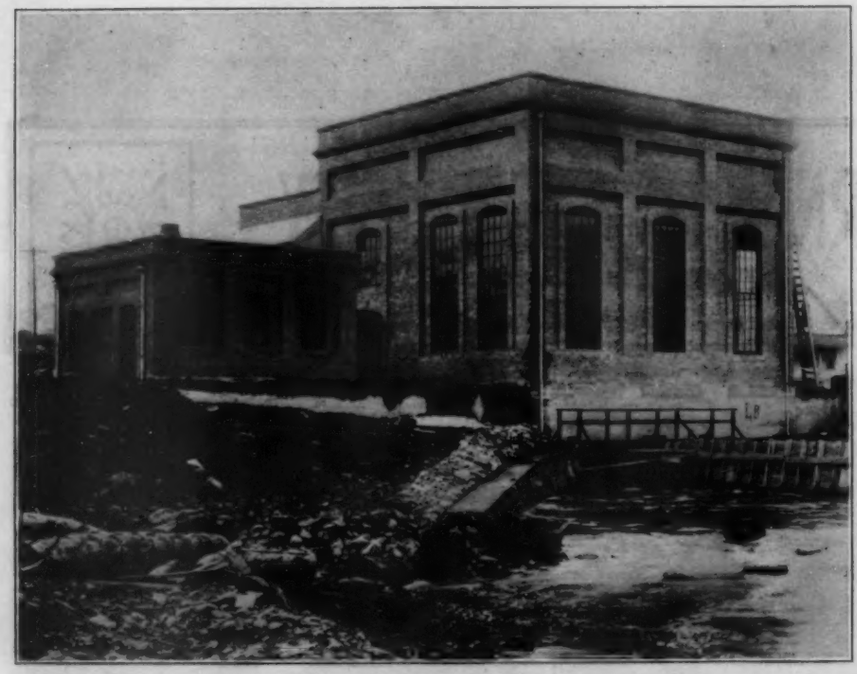
The construction of the Verdi development, the main hydroelectric station of which is located at Verdi, Nevada, represents a new accomplishment in difficulties overcome in transmission line construction. In addition to the main installation at Verdi the completed development consists of a dam across the Truckee River, a ditch, forebay, pressure pipe and its appurtenances, and finally a high-tension transmission line from the power station to Bluestone, via Washoe, Virginia City and Wabuska. This comprises a total distance in transmission of sixty-four miles.

In some features the construction of the transmission line is most interesting. The greater portion of it extends through an extremely rough country, making difficult the handling of materials and also the labor in their erection. On portions it was necessary to drag poles up long mountain sides by means of ropes and winches, and the transporting of small materials had to be done by hand or on mules. Most of the holes on the entire line were blasted from solid rock.

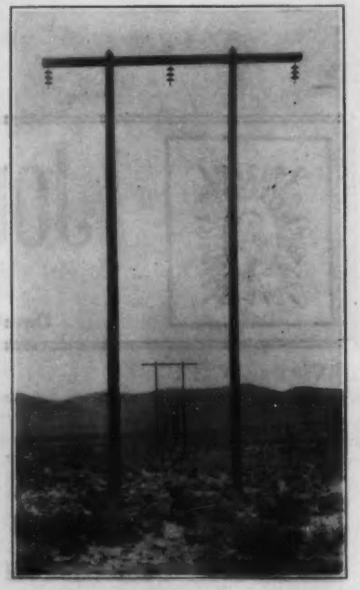
The pole line consists of two types of pole structure. The regular straight line structure is of two poles set vertically with a spacing of 12 ft. between their centers. The spacing of the poles and length of cross arms are such as to permit spacing the transmission line wires for operating at 104,000 volts. The average distance between these structures is about 400 ft. In the other type of structure four poles are used. These are placed in two pairs 12 ft. apart and each pair is erected with tops bolted together and butts 20 ft. apart, forming an inverted V.

The latter type is known as the "anchor structure," and is used at every half-mile in the straight line and at angles where it is necessary to hold the greater strain of the wires.

The power station is a brick building with steel frame, concrete floor and roof. The equipment in the station comprises a 2400 kilowatt generator driven by an Allis-Chalmers horizontal water wheel, two exciters, transformers for raising the voltage from that furnished by the generator to 60,000, which is required for the transmission line, switching equipment, lightning arresters and all necessary auxiliaries.



Power House and Tailrace.



Transmission Line.

In addition to the main station there are two houses, one for the chief operator and one for his assistant; also a shop and an oil storage and filter house, all of brick construction.

The pressure line consists of 790 ft. of steel pipe of 7½ ft. diameter at the power house end where the water pressure is the greatest, and 1430 ft. of wood stave pipe of 9 ft. diameter, between this section and the forebay. The pipe line is trenched and ballasted, with drains leading from it, and suitably located for disposing of seepage.

At the head of the pipe line are the forebay and flume of timber construction, which serve a double purpose; that of connecting the ditch with the pipe line and of making it possible, by use of gates, to obtain a closer control of the water admitted to the pipe. An overflow ditch leads from the forebay to the river for discharging excess water.

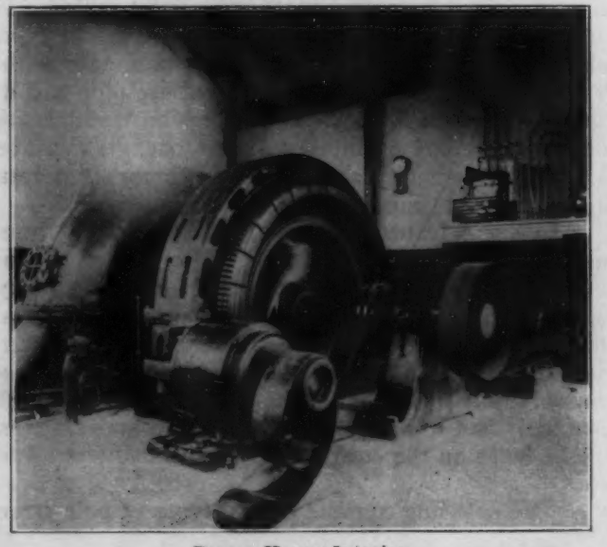
The main ditch is 10,200 ft. long and leads from the headgates at the dam to the flume and forebay. The earth in which the ditch was cut was heavily laden with large boulders, which caused difficult excavation and difficult work on embankments, and on considerable portions of it, formations of rock were encountered which required drilling and blasting. There was an equivalent of 205,000 cubic yards of earth removed in the excavation of the ditch.

The cost of the work was originally estimated by Stone & Webster Engineering Corporation at $663,000. A small amount of additional work, aggregating some $6325, was later authorized. The actual total cost was approximately $676,300, or within about 1 per cent of the estimate.

The dam is of wood crib construction, with interior rock ballast and sheathed on the outside. The river bed is excavated to solid rock upon which the dam is built.

It was originally planned by rush work, with the

Wood Stave Pipe.



Power House Interior.

use of large forces and extra amount of equipment, to complete the entire development, so that by August 20th power could be delivered, but it became apparent later that the power would not be needed by that time, and besides the advantage of employing normal forces, it was found that it would be an advantage to postpone work on the dam until later when the water in the river would be lower. With the work conducted on this basis, the development so progressed that power was actually delivered, and the transmission line connected with the system of the Truckee River General Electric Company on November 3, 1911.

All work was not then entirely completed and the plant was not ready for permanent operation, but on account of a shut-down of the plant at Reno, the Verdi plant was kept in service about three weeks. The Verdi plant was placed in regular operating service on December 19, 1911, and the system was formally turned over to the Truckee River General Electric Company on December 23d.

PUTTING IT UP TO THE MAN.

How the wide-awake executive develops a sense of responsibility in the man below him and fits him to bear the burden of responsibility is entertainingly told by Glenn C. Webster of the Buckeye Electric Lamp Works in a recent number of "Business." The following paragraphs form the introduction to the story and illustrate how it should not be done:

The general manager of a concern which manufactured electrical parts rushed into his office, peeled off his coat, jammed his hat on a rack, and cast a hopeless glance at a pile of letters stacked on his desk. It was not an exceptionally busy day. Neglected papers, usually from three to four days old, always awaited his attention. Only by long and uninterrupted effort did he succeed in disposing of them. After a perplexed pause he called his superintendent.

"Macadam," said he, "I have an idea. It's an idea I've wanted to carry out for a long time, but these things"—indicating the papers on his desk—"are taking up more and more of my time. I've decided to turn the whole thing over to you. I know you will work it out in good shape."

Whereupon he unfolded his plan and commissioned Macadam to carry it out. The idea was a good one, the superintendent agreed. Even while his superior was discussing the job, he began to scheme. In his mind's eye, he saw how each detail could be performed; followed the steps in logical order and pictured the finished fabric. He was fired with enthusiasm. Here was a task that called for brains, a real man's task, a chance to test his dormant ability.

Macadam was a good superintendent and the manager knew it. They rarely disagreed on the necessity for changes or improvements, although their methods of procedure in making them were quite different. The manager was quick-witted, impulsive and imperative; Macadam, thoughtful, deliberate and capable. Just as Macadam turned the door-knob the manager called him back.

"I want this thing done according to my ideas," said he; and forthwith, he gave definite instructions which were to be followed.

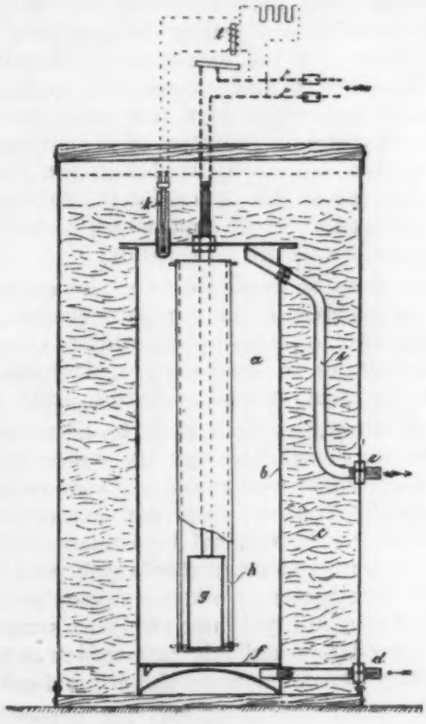
Unfortunately, the superintendent's mind had been started. His plans were just complete enough to interfere with the manager's, but not complete enough to form a working basis for the task as a whole. Neither of them realized it; yet the manager had jerked responsibility back upon himself like a ball at the end of a string. Back at his desk in the factory, the superintendent thought it all over. He did not know why; but his enthusiasm had chilled. He wanted to go back and argue it out, but the manager was invariably enveloped in an atmosphere of business that made interviews all but impossible; besides, interviews with the manager were monologues. He invariably did all the talking himself.

When the finished work was submitted, Macadam was not proud of it; nor was the manager pleased. It was the unsuccessful expression of two radically different minds.

EQUALIZING OF LOAD CURVES.

An attempt is being made on all sides to invent energy storing apparatus whereby energy generated in off-peak hours may be conserved to assist in hours of peak load. A foreign publication has recently set forth ideas of A. Rittershausen as follows:

The chief problem of central stations is to equalize the load curve and to encourage consumers to use energy during the daytime. This is possible only when the energy is stored in a form useful for domestic purposes, such as a hot-water storage apparatus of the type shown. The cold water enters at the bottom at



d; the hot water leaves at the top at e; c is a layer of infusorial earth which serves as a heat insulator. In order to make sure that hot water can always be drawn off from e, it is necessary that the cold water which enters through d shall not stir up the hot water above. For this reason the perforated plate f is provided. A definite circulation of the water is, however, necessary in order to heat the cold water. For this purpose the heating resistor g is surrounded by a cylinder h. The water within the cylinder is heated and rises, and cold water enters the cylinder from the bottom and so on.

READINESS TO SERVE METHODS

THE UTILITY VERSUS AGRICULTURAL SALES.

BY ROSS B. MATEER.

The awakening of the central station to the value of industrial power business was not sudden, but rather the result of pioneer work on the part of a few commercial engineers who dared to seek for business of a better load factor for the utility. Line extensions were grudgingly granted for power business, but generously allowed for residential lighting. Yet today the revenue accruing to central stations from the use of the electric motor is greatly in excess of that received from incandescent lighting.

A few lights operating for a short period of time at a high rate are not sufficient to warrant the use of the electric plant except from dusk until midnight. The industrial power load results in 24 hours a day continuous operation with an annual load factor of 50 per cent, which may be further increased to 70 or 75 per cent by encouraging agricultural uses for electricity.

Apparently few remember that the cities of large population today were the villages and hamlets of a few years ago and that the electric lighting station of the village was the nucleus of the many million dollar corporation and realize that with the expenditure of money for the extension of electric service into rural districts new towns will spring up and grow into cities, which in a few years will produce an annual revenue far in excess of the original investment. Pioneer work was needed in the past and is more in demand at this period for the development of the vast acreage of fertile land, which under irrigation will produce the wealth of a nation.

Will money be expended freely for such business as is to be secured in the populous centers and will the management of quasi-public utilities awake to the great possibilities in developing agricultural current sales, are the much-mooted questions of the day.

Many companies limit their investment in rural extensions by demanding that the entire sum be returned in current consumption in a year or two. Yet to attempt to construct lines and expect rural contracts to return the original investment in less than three years time and claim that a policy of this kind is pioneer development work is a fallacy and a direct evidence that a utility is not ready to serve its product at a moderate and fair rate sufficient to secure a just and reasonable sum on the original investment.

That liberal line extensions are needed for irrigation purposes, is evident when it is realized that only a small portion of our dry and at present fertile land is developed by the use of water from canals. The necessary flow must therefore be secured by pumping from the underground channels if agriculture is to be fostered in rural sections.

It has been stated that to judge a man, one must associate with him. Similarly, to pass an opinion on the land, its possibilities and needs, one must familiarize himself with the soil, not through an inspection trip at sixty miles an hour, but practical experience and the knowledge gained by those engaged in furthering current sales.

Sale Organization.

The development of agricultural current sales is best accomplished by the creation of an agricultural department of a central station with authority to promote the sales of current in rural sections by creating a market for current to be used for lighting, domestic, heating and power purposes. Such a department should be separate from all other utility activities and assume all responsibilities for the sales of electric current in all rural sections, which comprise all lands not included in the incorporated limits of town or city.

The methods used in developing the business, the investigation of a prospective customer's needs, the recommendations on the proposed equipment and the supervision of the apparatus by periodical inspection, should all be under the control and direction of the manager in charge of this important revenue producing department.

Such a sales and engineering organization should consist of a manager in charge, a competent industrial engineer for investigating steam and internal combustion engine, operated installations, supplying such comparative data as may be required and for conducting tests as to the relative efficiencies of competitive apparatus. Sales engineers, those versed in dealing with the customer, should be used to obtain the confidence of the farmer, contracting for his business. Such salesmen should possess personality and a knowledge of the agriculturalist and his needs, convincing him of the advantages to be secured by the use of current.

For general information, a cabinet index of the apparatus in use and equipment contemplated is maintained in the general offices. Such data cards should show each year the current consumption of each installation, the acreage under cultivation, and the tonnage output in crops from which may be obtained comparative data for use in districts possessing similar soil and subject to the same climatic conditions. Data of this character is readily obtained at the close of each season and following an inspection of the apparatus.

It is possible for the central station to co-operate with the settler who has recently acquired land, giving suggestions as to the crops best suited to the land to be placed under cultivation.

In fact, "Readiness to Serve" on the part of the electric lighting company means full co-operation with the agriculturalist, taking a chance on the line extensions, if you please, and aiding to produce the wealth at present characteristic of the soil.

That such a policy is profitable both to farmer and utility and is productive of revenue, is evident from the examples quoted in succeeding papers. It is with the purpose of infusing new activity into the policy of some utilities now dormant, encouraging them to

reach out for a market for their product, expressing their willingness to serve current, establishing, if you will, a policy of co-operation with the farmer, resulting in the development of his land, and increasing the popularity of electric service that the attitude of the public utility is criticised.

JUSTIFICATION OF DEVIATIONS IN RATES FOR ELECTRIC SERVICE.

BY S. M. KENNEDY.[1]

There are two commodities handled by this company, gas and electricity, the production and distribution of which resemble each other in some respects, and are widely different in others. Each commodity is generated at a central plant, and delivered to consumers by means of suitable distributing systems—the one underground and the other mostly overhead. The amount of each commodity used by consumers is measured by meters set on the consumers' premises, and bills for service are usually presented and paid monthly. Just about this point the resemblance in handling the two products ceases.

We frequently hear the question asked by certain of the public, "Why cannot electricity be sold in the same manner as gas?"—that is, a flat price per unit of measurement. Now, there are several reasons why there must be different methods of charge, the principal reason pertaining to the method of generation. Gas may be manufactured at any suitable or convenient time of the day or night, and stored until the consumer desires to use it. Electricity cannot be stored (except to a very limited extent, and at great expense), and consequently must be manufactured the instant it is required. The generating capacity of a gas plant may be much less than the "peak" of the load, but the generating capacity of an electric plant must always be at least equal to the "peak."

We are in the habit of referring to a "service" of gas or electricity. Now "service" refers not only to the commodity supplied, but the availability of the supply. The extent of the service furnished any consumer consists in the quantity of gas or electricity consumed plus the amount of plant capacity maintained on his account and subject to his demand. But it will be noted that the generating capacity of a gas plant does not bear the same relation to each consumer's demand as does the generating capacity of an electric plant, the reason being that the former may be conveniently stored and the latter cannot.

There are three fundamental factors which must be considered as forming a basis in charging for electric service, namely, quantity, demand, and hours of use. It is in connection with the variation in these three factors, which different classes of service call for, that the apparent necessity for variations or deviations in rates enters into consideration.

The circumstances and conditions surrounding the supplying of electric service differ more or less in the case of each individual consumer. However, there are certain characteristics which are to a great extent constant in all installations in which the uses of the service are the same or very similar. Service for lighting is usually required during the night and the demand is largely influenced by the season of the year. Service for power is generally required during the daytime, and the demand continues fairly regular throughout the year, although our pumping load is heaviest during the summer months.

The intention of this paper is not to deal with the different methods of charging for lighting and power service. There has been much talk of so-called scientific rate schedules, which have been put into effect in various parts of the country, which schedules are supposed to automatically take care of variations in service conditions. In California the great demand from all directions is for a low maximum rate, and because of the wonderful diversity of the connected load of the Southern California Edison Company, a low maximum rate for lighting service has been made possible, but it cannot be said it has been arrived at scientifically.

In the lighting business there appears to be less necessity for deviations and variations than in the power business, because every one wants service during the hours of darkness, but, properly speaking, there are great differences in the values of various kinds of lighting loads. Take, for instance, a residence with, say, one hundred lamps installed. It seldom happens that more than fifteen or twenty of these lamps are in use at one time, and these only for an hour or two nightly, yet all of the hundred lamps may be in use at once two or three times each year. The average monthly consumption in this case is probably sixty kilowatt hours.

Now, then, let us look up the case of the little drug store "'round the corner" from the residence aforementioned. It has an installation of only thirty lamps and uses twenty of them every night in the year until 11 o'clock. The average monthly consumption is 120 kilowatt hours, and the demand on the company's capacity less than one-third that of the residence.

Again, let us consider the big department store with two thousand lights installed, closing at 6 o'clock every business day. Its average monthly bills are no more than that poolroom near by, with less than two hundred lights burning every night until 12 o'clock. Then there is the church with its five hundred lights used once or twice a week. From the electric company's standpoint the little theater using one hundred lights every night is much better business, and undoubtedly the theater is entitled to a lower rate per kilowatt hour than the church for the energy used for illuminating purposes.

For lighting service, the quantity of energy consumed should not alone govern the rate per kilowatt hour. The demand each consumer is liable to make upon the company is of equal importance, and the relation of the kilowatt hours used to the maximum demand is what justifies deviations or variations in electric lighting rates.

We now turn our attention to the use of electric energy for power purposes, and here we find a greater number of variations in uses than in lighting, and these variations seem to be on the increase as the electrical business is developed. It will be remembered that originally central station plants supplied lighting service only; all through the daylight hours they stood idle, and the lighting income alone had to bear the

[1]General Agent, Southern California Edison Company.

entire fixed charges on the investment. The utilization of the investment for a greater proportion of the time became the problem and anxiety of electric companies, and as a consequence the power business was sought. It was argued that energy could be sold at lower rates if used only in the daytime, because the fixed charges would be practically the same, and the only additional expense would be operating costs. This was the first attempt at justification for deviations.

We all know how the power business has since developed, particularly in California, and that in our own company the kilowatt hour output is now five times greater for power service than for lighting. This large power business has been built up by the careful consideration of the three fundamental factors referred to—quantity, demand and hours of use.

Let us now consider the different classifications of power business and their relative value to the company in load building. They might be enumerated as follows:

FIRST. OPTIONAL SERVICE: Service that the consumer may take at any time of the twenty-four hours according to his necessity and convenience.

SECOND. DAYLIGHT SERVICE: This service covers such industrial business as takes power only through the ordinary working hours of the day, using no energy after 5 p. m.

THIRD. 20-HOUR SERVICE: Service used constantly except during the four hours of peak.

FOURTH. CONTINUOUS SERVICE: Service used every hour of the day, which means continuous use of a portion of the central station plant's capacity.

FIFTH. VALLEY SERVICE: Service which is used only between midnight and 6 a. m.

SIXTH. PUMPING SERVICE: Service usually taken for only six months during each year and used for pumping water for irrigation purposes.

SEVENTH: WHOLESALE SERVICE: Power service sold to other companies or to municipalities for resale.

EIGHTH. EMERGENCY SERVICE: Service used as "stand-by" to private electric, steam or gasoline plants.

In the foregoing classifications no reference has been made to the factor of demand, although it should properly enter into each, when the question of rates is under consideration. In other words, the more or less constant use of the connected load or maximum demand of each power customer, largely represents the value of each customer's business to the company. This is called the load factor. It is an axiom in the business that the higher the load factor, the lower should be the rate. This is the prime reason or justification for variation in rates for electric power service.

There are other reasons which contribute to the justification for deviations, such as proximity to point of generation, delivery of energy from high tension lines, consumer paying for line extension and substation equipment, temporary contracts for surplus water power, experimental work and other special conditions and circumstances unusual as far as the general service is concerned.

Rate-regulating bodies are now practically agreed that there may be discrimination in charging for electrice service as between the different classes of customers supplied, but that there shall be no discrimination betewen individual consumers of the same class.

In this connection information has been asked from some of our districts regarding the reasons for the different classifications in the existing power schedules of this company effective in territory outside of the City of Los Angeles.

What is termed the "standard power schedule" is on the block system, having eight divisions with a separate rate for each block. This applies to all power business not provided for in separate classes, and the service is unlimited as to hours of use. The deviations to the standard schedule are the following:

CLASS "A"—Pumping Plants. Because these pumping plants usually operate during the months when energy is used least for lighting purposes, and also because when in operation the load factor is usually good, and further because suitable guaranteed monthly mimimum payments are provided, the special rates are considered justifiable. In contracts under this class the company always reserves the right to discontinue service during four hours of "peak" daily.

CLASS "B"—Refrigeration, Rock Crushing, Brick Making and Woodworking. Each of these different industries usually gives a steady load while operating and the use of power is confined to the daylight hours. The special rates provided are protected with suitable monthly minimums.

CLASS "C"—Laundries. Contracts in this class are usually for auxiliary service. Laundries must have a steam installation to carry on their work and an electric service prevents additional steam installation as each laundry develops its business. The laundry load is steady and entirely off peak and the rates are protected by suitable minimums.

CLASS "D"—Cooking and Heating. This is given to encourage the use of electric cooking and heating for domestic purposes.

CLASS "E"—Provides for large installation and is now practically superseded by the schedule in Class "G."

CLASS "F"—Consumers using a large amount of power in the valley and no power on the peak. It is probable that a definite schedule for such service will shortly be prepared, as new conditions require that the rates be specifically stated.

CLASS "G"—Load Factor Schedule. This is really a wholesale schedule and open to all classes of power business. The minimum connected load to which it may apply is 75 horsepower and the minimum monthly bill must be equal to $2.00 per horsepower. The monthly rate per kilowatt-hour depends on the more or less continuous use of the connected load.

It will be remembered that we entered into a new era of regulation on March 23, 1912, when the State Railroad Commission took over the control of public utility rates, and that in this respect we are no longer a law unto ourselves. However, we do not anticipate any radical changes in the methods of charging for service heretofore adopted by this company.

ELECTRICAL PUMPING AND IRRIGATION

FORM OF CROSS SECTIONS OF CANALS.

BY B. A. ETCHEVERRY.

To determine the form of the cross section when the carrying capacity, grade and velocity are known the following factors must be determined:

1. Proportion of bed width to depth, or the desired bed width, or the depth.
2. Side slopes.
3. Top width of banks.
4. Height of top of banks above water line.
5. Desirability of berms.

These factors will be discussed under the following sub-headings:

a. The construction, lined or not lined.

b. The material through which it passes, sand, loam or rock.

c. The topography of the country, level ground or side hill.

d. The purpose for which the canal is intended, diversion line, main canal, lateral or farm ditch.

e. The volume of water to be carried.

f. The cost.

Canals in Earth Not Lined and in Level Country.

1st—Proportion of bed width to depth.

The relation between them is best illustrated by the following example. Three canal cross sections have been taken. They have the same carrying capacity, 300 cubic feet per second, and are under the same conditions. For all sections the grade is 4.5 ft. in 10,000 ft., the coefficient of roughness .025, the side slope 1 to 1, the width of the top of the bank 10 ft., and the height from the full supply water level to the top of the bank 2 ft. The first section is the one of least wetted perimeter, the second and third are shallower sections. The results obtained are:

Elements of canal section.	First Canal Section.	Second Canal Section.	Third Canal Section.
Base width in ft.	6.13	15.75	39.0
Water depth in ft.	7.40	5.00	3.00
Wetted perimeter in ft.	27.05	29.90	47.50
Area of water section in sq. ft.	100.00	103.75	126.0
Average velocity in ft. per second.	3.01	2.90	2.40
Depth of cut in ft. for balancing cut and fill	6.35	3.97	1.95
Height of fill in ft. for balancing cut and fill	3.05	3.03	3.05
Volume of cut in cu. ft. per lin. ft.	79.4	79.0	79.7
Height of water surface above original ground surface	1.05	1.02	1.05
Volume of water above original ground surface based on average velocity	41.2	60.0	104.50

(a) The above comparisons show that the wetted perimeter for the shallow sections, especially for section 3, is much greater than for the deep section having the best hydraulic elements. This increase in wetted perimeter will give a large seepage loss; on the other hand the smaller depth will tend to diminish the rate of seepage. The relative effect of each may be estimated as follows:

Let S = seepage per unity of length.
A = cross sectional area of waterway.
d = depth of water.
C = constant.
t:1 = side slopes.

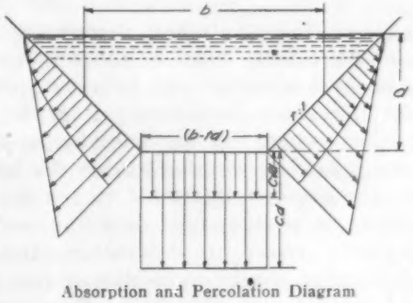
If the intensity of seepage is proportional to the square root of the depth, then it can be represented by $C\sqrt{d}$. The average intensity of seepage on the sides is ½ the intensity on the base. Therefore the total

Steam Grader at Work—Truckee-Carson Project, Nevada.

seepage is equal to the base width multiplied by the intensity plus the length of the side multiplied by ½ the intensity on the base, or

For the canal sections assumed above we have:
Seepage for first canal section, $S = 54.6\,C$
Seepage for second canal section, $S = 56.3\,C$
Seepage for third canal section, $S = 77.3\,C$

This would indicate that the seepage loss for the deep canal is less than for shallow canals. Based on the assumption that the intensity of seepage varies with the depth instead of with the square root of the



Absorption and Percolation Diagram

depth, the equation would then be $S = C\,(A + 0.41\,d^2)$, and the seepage for the above three cases would be 122 C, 144 C and 130 C. Based on this assumption the seepage would be least, not for the deepest section, but for a moderately deep section. No consideration was given to the temperature. The lower temperature

obtained in the deeper section would be an advantage in lowering the seepage losses.

(b) The area of water cross-section is least for the deeper section, consequently the area of excavation would be less for the deep section than for a shallower section when the canal is all in cut. However, the unit cost of excavation would be higher because of the greater depth and may increase the total cost. But even then, where the canal is to be lined with some expensive lining, such as concrete, the increased cost of excavation would probably be more than balanced by the decreased cost of lining a smaller wetted perimeter.

(c) The amount of excavation, when cut is equal to fill, seems to be nearly the same for all sections. The smaller unit cost of excavation for the shallow canals would make the shallow section more advantageous in this respect.

(d) The velocity for the deep section is higher and would produce a smaller seepage rate.

(e) The difference in elevation between the water surface and the ground surface is practically the same for all three sections, but this depth represents a greater volume of water with the wider section.

Excavating Farm Laterals With Fresno Scraper—Modesto Irrigation District, California.

The above deductions and theories as well as a number of other facts tend to show that of several sections, in level country with balancing cut and fill and under the same conditions of grade, carrying capacity, side slopes, top width of banks and coefficient of roughness, the section having the least wetted perimeter (or greatest hydraulic radius)is the most advantageous as regards cost of lining, volume (but not necessarily cost) of excavation, and velocity. These advantages would make this section preferable for a lined canal or a canal in rock. On the other hand the disadvantages are (1) decrease in safety, especially when the canal is in fill which is very desirable for laterals and farm ditches; (2) difficulty in maintaining side slopes in a deep canal requiring flatter slope than for a shallow canal or the use of berms; (3) smaller proportion of the total volume of water held above the ground surface, making diversion into laterals or application to the land more difficult; (4) difficulty in excavating deep canals with ordinary methods of canal excavation.

The above relations have been deduced from canals under the same condition for grade. It often happens, however, that it is desired to use a fixed velocity in which case for a given carrying capacity the area of cross section would be the same and the grades would be computed accordingly. The section of least wetted perimeter would then require a smaller grade but would give a larger amount of excavation for a balancing cut and fill section in level country.

For these reasons the form giving best hydraulic elements is rarely used for irrigation canals, except where the canal is on side hill, or is lined, or in hard material expensive to excavate. The above examples show that the wetted perimeter is not much greater when the canal is not excessively wide and that the seepage may be less for a moderately deep canal than for a very shallow or very deep canal. The practice has been to adopt excessively shallow canals; while this may be necessary and desirable for the distribution system, it is not usually economical for the diversion canals, where a moderately deep canal is best. The proportion of bed width to depth varies greatly with the ideas of engineers. The following empirical rules represent good engineering practice for ordinary main canals in earth.

First empirical rule.

Carrying Capacity.	Make Depth in Feet.
1,000 to 1,500 second ft.	6 to 9
750 to 1,000 second ft.	4 to 8
400 to 750 second ft.	3 to 6
300 to 400 second ft.	3 to 5½
200 to 300 second ft.	3 to 5
100 to 200 second ft.	2½ to 4½
100 or less second ft.	2 to 3½

Second empirical rule.

Carrying Capacity.	Make Width.
1400 second ft.	Not less than 5 x depth
1000 second ft.	Not less than 4 x depth
500 second ft.	Not less than 3 x depth
300 second ft.	Not less than 2 x depth

F. W. Hanna, Project Engineer for the Payette-Boise project, U. S. Reclamation Service, recommends the following proportions of bed width (b) to depth

Typical Illustration for Determination of Cross-section and Side Slopes of Ditch

(d) for laterals of the distribution system: $b = d^2 + 1$, where the fall is slight, and $b = 2d^2 + 2$, where the fall is abundant.

2d. Side slopes.

The correct inside slopes of a canal depend mainly on the character of the material. The inside slopes generally used are: for loose sandy soil, 2 horizontally to 1 vertically; ordinary sandy loam, 1.5 horizontally to 1 vertically; ordinary firm soil, 1 horizontally to 1 vertically; hardpan or very firm soil, ¾ or ½ horizontally to 1 vertically; solid rock, ¼ horizontally

to 1 vertically. The section with the smallest area of water way for a given grade has side slopes of about .6 horizontally to 1 vertically. To facilitate excavation and diminish the cost of construction, the canal is frequently given side slopes of 1½ to 1, or 2 to 1, and the bottom and corners are slightly curved giving the section the form of the segment of an ellipse. This is usually the case for laterals and farm ditches in ordinary earth excavated with Fresno scrapers. The outside slopes of an embankment are usually 1½ to 1 and may be as flat as 2 to 1 for very loose sandy soil.

3d. Top width of banks.

For main canals and main laterals, the top of the bank is often used as a private roadway for ditch tenders' carts, in which case the width must be not less than eight feet. If not used for a roadway, the width to be given will depend on the size of the canal and on the soil, on the depth of water, especially on the proportion of the depth in fill, and on the importance of preventing a break.

For Canals with Carrying Capacity of	Top Width Should Be
1500 second ft.	Not less than 10 ft.
1000 second ft.	Not less than 8 ft.
500 second ft.	Not less than 7 ft.
300 second ft.	Not less than 6 ft.
200 second ft.	Not less than 5 ft.

A general empirical rule would be: Top width = Depth of water + 2.

For distribution laterals: Top width = Depth of water, with a minimum of 3 feet.

4th. Height of top of banks above water surface.

The following heights are generally used: for large deep canals a maximum height of 3 ft.; for main laterals a height of 2 ft.; for smaller laterals carrying 50 to 100 cu. ft. per second, a height of 2 ft. to

Steam Shovel Excavation—White Valley Irrigation System, British Columbia.

1½ ft. For canals carrying 50 cu. ft. per second or less, a height of 1 ft. There is no advantage in more than this. If stronger banks are necessary, the extra material can be used to better advantage by increasing the width and not the height.

5th. Desirability of berms.

Berms are not commonly used in irrigation canals. Their use is justified in deep cuts where the surcharge of the earth above the water line may cause caving. For deep canals when the channel is partly in cut and partly in fill a berm from 2 to 6 ft. wide is sometimes left between the top of the bank in cut and the bottom of the fill. In deep cutting where the excavated material is run to waste, a berm of 6 to 10 ft. wide should be left between the top of the cut and the bottom of the waste bank slope.

Side Hill Sections.

Proportion of bed width to depth.

Where the section is in rock or in firm soil, the canal section should approach as much as practical the section with the best hydraulic elements.

Depth of water in canal.

To insure against breaks, it is very important in side hill work, especially steep side hills, that at least two-thirds of the depth of water be in cut. If a larger proportion is in fill the breaks will be greater and more frequent and the necessary repairs and vigilance are expensive.

Side slopes.

The side slope on the mountain side or cut side can generally be made steeper than on the fill side; for canals in ordinary firm side hill soil the side slopes commonly used are 1 to 1 on the uphill side and 1½ to 1 on the down hill side.

THE PUBLIC AND PUBLIC SERVICE CORPORATIONS.

BY F. K. BLUE.

Since it is a monopoly, the income on investment in a public service corporation depends entirely on the charges for service under given conditions of custom and operation. It is of great economic advantage to have such utilities for a given service handled by no more than one organization in each municipality or district, but if the rates are fixed in the interest of the investment only, they will bear no relation to cost of production and allow the consumer no advantage from economy of operation. It is desirable, therefore, for the public to discourage the uneconomical condition of competition, but to require such methods of fixing rates that they shall conform to those that would normally result under competitive conditions.

To do this it is necessary to follow arbitrarily the principles by which prices are established in normal competitive production. The paramount condition for the development of an industry is that the returns must be sufficient to induce workmen to do the work and capitalists to provide the equipment. At this point prices will correspond with those established by normal competition and will allow no fictitious valuation of investment. They will then conform to the normal cost of production.

To make the rates of public service corporations arbitrarily correspond with those established under normal competition it is necessary then to conform as closely as possible to the following principles:

(1) A policy and agreement with public service corporations should be established that will provide an acceptable return to investors in the securities of the corporation but which will not produce a material change in the value of such securities on account of the rates for service that are allowed.

(2) Provision should be made that earnings shall finally depend on definite service rates previously fixed, to continue throughout stated intervals of time—conveniently, one year.

(3) The value of securities depends not only upon present returns but upon prospective future returns. So that when future income is likely to vary, then the value of the security will not correspond with the present rate of return, but will be the present value of all estimated future returns. The probability of future losses must also be discounted by larger returns in the present and early losses and costs must be provided for by greater dividends in the future. It may often be more desirable for the consumer to assume some of the risks of the uncertain future than to pay the higher rates required when they are all borne by the stockholders. So in order to command a low rate of return on an investment it may usually be desirable to reduce its speculative character as far as possible by providing for an extension of franchise until all capital and income agreed upon has been returned to the investor or purchased by the municipality at a valuation provided by the terms of the franchise. The investment return ought then to approach the rate of interest on the value of the bonds of the same corporation.

Principles Applied in Automatic Method of Rate Fixing.

A method of rate fixing based on the actual returns on the market value of the stock of a public service corporation may be provided which will automatically hold its dividends to a rate which is acceptable to the original and all future investors in the stock and which will prevent its market value from varying greatly from the actual original investment or the physical valuation including legitimate intangible values. This method will secure to the consumer all the economic advantages of monopoly and also rates for service conforming to these that would be established under normal competition.

Until a public utility is built up to a paying basis at reasonable rates for service, expedients for deferring dividends must be carried out, but when finally established the principle of the operation of this method may be roughly outlined as follows:

The physical valuation of the properties of the corporation is assumed to be established to correspond to the actual legitimate investment upon which the stockholders are entitled to receive dividends. This valuation will be altered for purchases and sales of properties and changes in the value of real estate in service and gold.

For convenience the par value of all outstanding securities should correspond with the physical valuation of the properties.

To fix the rates for any given year the probable operating expenses should be estimated from the actual expenses during previous years according to definite methods stated in the terms of the franchise and conforming to the nature of the utility. This should include all charges except dividends and any sums that may be set aside to the credit of the city.

To the above amount should be added a sum which would make the probable rate of return on the physical valuation of the properties equal to what was the rate represented by the actual amount credited to stockholders during the previous year relative to the average value of the outstanding stock during the previous year as represented by the market quotations of prices asked. A provision must of course be made that the stock must not be withdrawn from the market.

Based on the revenues of previous years and according to definite methods stated in the franchise a nominal rate of service should be estimated to provide a probable revenue equal to the operating expenses and dividends to stockholders as estimated above.

The actual rates for service may be fixed at a higher point if it is desired to apply the difference towards the accumulation of a fund to be placed to the credit of the city for the purchase of the utility from the corporation.

This method of rate fixing would act like a relay governor in mechanics, the economic forces interacting in such a manner that any variation from the normal would be met by an opposing force which would tend always to bring the relations to a stable equilibrium at the point where the value of outstanding securities would equal the physical value of the properties and the return on the investment would equal that which an owner of stock would just be willing to forfeit by its sale.

When this method of rate fixing is followed the speculative value of the stock of the corporation will be confined to the possible increase or decrease in earnings during the year. The exact amount of this return also depends upon economy of operation and management during the year as it ought to do.

The method of fixing charges for service being defined by the terms of the franchise, disputes between the city and the corporations would be avoided, and the return on the investment being actually determined by the investors at their own rates, the grounds for contesting such rates on account of confiscation of property would be removed.

Similar methods are applicable to the regulation of prices in case it is decided to establish government control of trusts instead of attempting to hold prices to cost of production by restoring competitive conditions.

Legislation Required to Put Such Principles in Practice.

In order to apply modern methods of franchise adjustment and rate fixing in San Francisco, it has been found necessary to provide amendments to the charter which will allow franchises to be granted upon terms which investors can afford to accept and yet which will also safeguard the interests of the public. The present charter requires such onerous conditions in regard to term of franchise and share of gross revenue that must be paid to the city that investors in street car lines cannot hope to get an acceptable rate of return on investment and also have their capital returned before the term expires. By the proposed amendment, No. 34, to be voted on December 10th, these matters are provided for, so that the city will be able to grant franchises which will be acceptable to investors and yet which will not allow a valuation of the properties of the enterprise above that represented by real and legitimate investment.

SCIENTIFIC PLANT MANAGEMENT

FUNDAMENTALS OF FUEL TESTING—SPECIFIC GRAVITY.

BY J. P. ZIPF.

The complete analysis of a western boiler test requires a knowledge of the oil used as fuel. An average sample having been obtained, further investigation is best carried out in a laboratory equipped for this purpose.

The specific gravity is conveniently determined on a Westphal balance as shown in Fig. 2. This consists of a balance arm supported on knife edges, from one end of which is hung a glass bulb, the other end

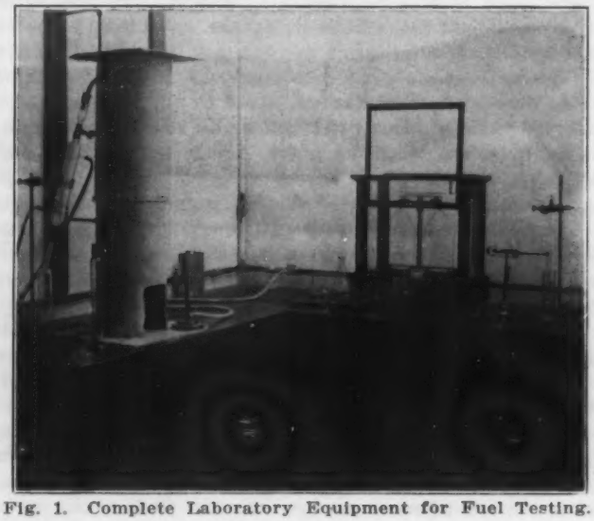


Fig. 1. Complete Laboratory Equipment for Fuel Testing.

being counter weighted. Along the balance arm are nine notches, the hook supporting the glass bulb being in the position of the tenth notch. The glass bob has a displacement of exactly 5 gms. of pure water at 4 degrees centigrade. Hence if the bulb were so immersed, a 5 gm. weight would establish equilibrium if hung from the hook. This would indicate a sp. gr. of 1.0000.

Adjustment consists in tilting the balance arm support by turning a thumbscrew, forming one point of a three-point support, until the pointers are opposite each other, the bob being unimmersed. For specific gravities less than 1.0000 the 5 gm. rider (called the "unit-weight") is hung in a notch such that equilibrium is nearly reached, but not exceeded. This gives the first decimal place. The 1/10, 1/100 and 1/1000 unit weights are hung respectively in notches so that equilibrium is finally established. The specific gravity is then read directly to four decimal places by noting the notches in which the riders hang, commencing with the largest rider.

The oil sample should be allowed to stand in the laboratory several hours before determinations are made, in order that any drops of water in the oil may settle. A small quanity is then poured from the sample can into a suitable glass jar. The Westphal balance, having been dusted with a soft brush, is adjusted to equilibrium and the specific gravity of the sample obtained, together with its temperature.

As specific gravity is usually referred to a temperature of 60 degrees F., another determination must be made at a temperature differing by 15 degrees F. to 20 degrees F. from the first. The temperature of the sample in the jar may be raised by immersion in a water bath, great care being taken to allow no water to get into the oil. For example let us consider an oil, two determinations of which are:

The specific gravity (S_1), 0.9582 at a temp. (t_1) of 68.9° F.

The specific gravity (S_2), 0.9525 at a temp. (t_2) of 86.5° F.

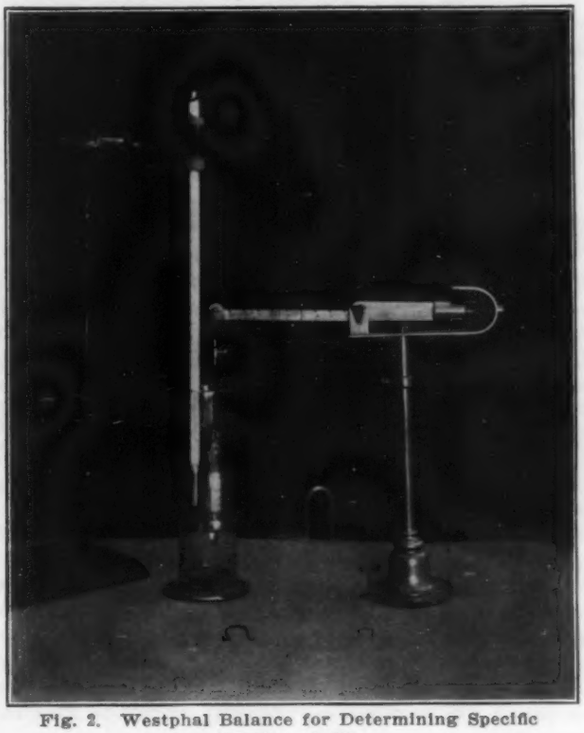


Fig. 2. Westphal Balance for Determining Specific Gravity of Oil.

$\frac{(S_1 - S_2)}{(t_1 - t_2)}$ is the change in sp. gr. for 1° F., over the range t_1 to t_2. This change in specific gravity for 1° F. is the coefficient of expansion of the oil. Thus in this case the coefficient of expansion is

$$\frac{.9582 - .9525 = .0057}{68.9 - 86.5 \quad -17.6} = -.000324 = C$$

The coefficient of expansion will vary with different oils from —.00027 to —.00042.

Then at 60° F. the gravity will be

$S_1 + C\,(60 - t_1)$ or $S_{60} = .9582 + [-.000324\ (-8.9)] = .9610.$

The oil is referred to the Baume scale by the formula

$$B = \frac{140}{\text{sp. gr.}} - 130$$

This oil then, has a gravity of 15.68° B.

The oil in the glass jar should be poured back into the container. The bob is cleaned by immersing in benzene and wiping dry, and the glass jar by simply wiping free from oil.

THE ROSEBERRY LAW AND WORKMEN'S COMPENSATION.[1]

BY W. A. CHOWEN.

In order to more fully understand and appreciate the Roseberry Law, let us first briefly review the conditions which surrounded the recovery for occupational injuries under common law as they existed prior to the enactment of the Roseberry Law.

The master was liable for injuries to his employees,

(1) Caused through the wrongful act, neglect or default of himself or a vice-principal, i. e., foreman or superintendent in his employ;

(2) Caused by machinery which was out of repair or unsuited for the use for which it was provided;

(3) Caused by his failure to provide a safe place or appliances for his employees' use; or

(4) Caused by his failure to properly warn or instruct his employees of dangers which were not patent or apparent.

On the other hand, no recovery could be had in cases where the injury was caused by a fellow employee of the injured.

Or where the carelessness of the injured party was the contributing cause of the accident.

Or where the accident arose out of the usual hazard of the business or work engaged in.

There seemed to be great reasonableness and justice in this order of things, that if the accident was caused by the master or his vice-principal or by reason of defective or unsuitable machinery or failure to provide a proper place for his employees to work, he should be called upon to make reparation, so far as possible, by financial contribution in terms of lost wages, medical expense, and, in exaggerated cases, for pain and suffering.

Also it seemed reasonable that the master should not compensate for loss by reason of the injured's own carelessness or the carelessness of a fellow servant or by reason of the inherent dangers of his occupation. Obviously, a man injured by his own carelessness should himself suffer the consequences; again, a fellow workman would be responsible for causing injury by his carelessness, and there would be a cause of action against him, but not against the master, and, lastly, no occupation can possibly be made absolutely free from danger, and so the compensation received from any given occupation was held to cover the risk dependent upon that occupation.

Clearly, then, under this arrangement of things there were many injuries sustained by workmen for which there was no recovery from the masters under common law. This being true, it not infrequently happened that employees suffered the loss of an arm or a leg or an eye, or life itself, and there being no right of recovery as against the master, were left as a public charge. Not only themselves, but all too frequently their families were left thus destitute. In other words, to use a favorite expression of Mr. Pillsbury, chairman of the Industrial Accident Board, "they were thrown below the poverty line." It was to relieve this condition among those engaged in the so-called "hazardous employments" that the system of compensation for occupational injuries was provided.

A system of compensation for occupational injuries and illnesses has been for some time in vogue in many European countries. It has been contemplated by various and several of the States in the United States for some years past, and the principal reason why it has not been sooner put into effect in America is because of the theory that to impose upon the industries of one State an obligation to reward employees for all occupational disabilities, regardless of the question of responsibility of the master, would be placing a handicap over the industries of one State as compared to those of a sister State which were not so burdened.

Regardless of the theoretical handicap which I have mentioned, several of the States have recently enacted compensation laws. These laws are quite similar in many respects, as having been designed to effect the same results, i. e. to relieve society in general from the charge of the permanently disabled, and to attach to each individual industry its proportion of the burdens due to accidents; a further theory being that to thus throw the burden of its industrial loss on each branch of industry will reduce the shock, as it were, and cause it finally to become an overhead charge against the production of that industry, eventually to be borne by society in general.

The Roseberry Law, which was enacted in California, and took effect September 1, 1911, was, I understand, very largely taken from the compensation law in force in Wisconsin. Our law provides that it is optional with the employer to elect whether or not he will be governed, in his treatment of the injuries sustained by his employees, by the so-called "compensation features" of the law. If he elects to be so governed he must give written notice to a body of men known as the Industrial Accident Board, which board consists of three members, appointed by the governor, with offices in San Francisco.

This notice must also be posted conspicuously throughout his place of business, and also placed on records, in order that whoever may be concerned will be able to determine whether or not he has made this election.

Having given this notice, the employer will be considered as being governed by the compensation features of the law from the date of the filing of the statement and thereafter, without further act on his part, for successive terms of one year each, unless he shall, at least sixty days prior to the expiration of such first or any succeeding year, file a notice in writing to the effect that he withdraws his election to be subject to the provisions of the act.

It then rests with his employees to be governed by the compensation features of the law, provided the master has elected, unless they in turn serve written notice upon the employer within thirty days of the date on which he gives such notice or date of his employment. Failing to give such written notice to the employer, the employee must then abide by the terms of compensation provided by the Roseberry Law, and cannot receive a greater sum for any given injury or disability than that provided in the law, except that when the injury was caused by the personal gross negligence or wilful personal misconduct of the employer or by reason of his violation of any statute designed for the protection of employees from bodily injury, in which event the employee may either claim compensation under the act or maintain an action for damages under common law.

In the event of the employer failing to give such notice of his intention to be governed by the compensation features of the law, he is then subject to the terms of common law governing actions for personal injuries, but the Roseberry Act provides further that should the employer not elect to take advantage of the compensation features by giving notice as herein outlined, then he shall be subject to common law, and it shall not be a defense:

(1) That the employee either expressly or impliedly assumed the risk of the hazard complained of.

(2) That the injury or death was caused in whole or in part by the want of ordinary or reasonable care of a fellow-servant.

(3) The fact that such employee may have been guilty of contributory negligence shall not bar a recovery therein where his contributory negligence was slight, and that of the employer was gross in comparison, but damages may be diminished by the jury in proportion to the negligence attributable to such employee.

[1]Address before Electrical Development League, San Francisco, November 12, 1912.

In other words, the doctrines of negligence of fellow-servant and assumption of risk are expunged, and the question of comparative negligence is left for the jury.

It is a little difficult to say exactly what percentage of cases are governed by these three rules, but the Industrial Accident Board, which has given the question very serious consideration for a number of months, has come to the conclusion that the obligation of the employer has increased approximately 400 per cent by reason of the elimination of these three defenses as compared to similar actions at common law under the conditions as outlined in the opening of this paper.

Among employees who are covered by this law are included aliens and also minors who are legally permitted to work under the laws of the State. The act also expressly states that any person whose employment is but casual and not in the usual course of the trade, business, profession or occupation of his employer is not included under the compensation features. Just who is included under this latter classification, however, has not yet been fully decided. It is given as the opinion of the Industrial Accident Board that this means domestic servants, for instance, as these servants are not employed in the course of the trade, business, profession or occupation of the employer.

The compensations provided by the act are such medical and surgical treatment, medicines, medical and surgical supplies, crutches and apparatus, as may be reasonably required at the time of the injury and thereafter during the disability, but not exceeding ninety days, to cure and relieve from the effects of the injury or the furnishing of such treatment and appliances not to exceed the sum of $100.

For total disability, 65 per cent of the average weekly earnings, provided the disability shall have lasted seven days, in which event compensation shall be paid for the first week's disability, but the total of such compensation shall not exceed three times the average annual earnings.

If the disability is partial, then 65 per cent of the weekly loss in wages shall be paid.

The period for paying compensation shall not extend beyond 15 years, which it might do in the event of slight permanent partial disability.

In the event of death, compensation shall be paid to the legal heirs, which, together with the compensation already paid (if death is not immediate) shall equal, but not exceed, an amount equal to three years' wages, which amount shall not be less than $1000 or more than $5000.

It must be borne in mind that this death benefit must be paid in the event of death occurring any time within a period of 15 years where the accident was the approximate cause of death within said period.

In the event of there being no dependents, the amount of indemnity collectible from the employer shall be $100 to defray funeral expenses.

The law also goes into detail as to the manner of computing these compensations, and also as to who shall be considered dependents, and as to the prior right of such dependents in accordance with the degree of relationship to the injured employee.

The law further requires that the employee shall submit to physical examination from time to time when required to do so by his employer, and in the event of his refusal to submit to such examination, his compensation shall cease, unless and until he shall have submitted to the physical examination. The Industrial Accident Board is also given the right to ask for physical examination in case the matter of the adjustment of the claim is placed before them for a decision.

The law also provides for the manner of settlement of disputes of any of these claims, which settlements shall be left with the Industrial Accident Board, and their action shall be final, and can only be set aside upon the grounds,

(1) That the board acted without or in excess of its powers.

(2) That the award was procured by fraud.

(3) That the findings of fact by the board do not support the award.

Upon the setting aside of any award by the Industrial Accident Board the court may recommit the controversy and remand the record in the case to the board for further hearing or proceedings, or it may enter the proper judgment upon the findings, as the nature of the case shall demand.

The law further provides that no claim for compensation under the act shall be assignable before payment, nor shall any claim for compensation, or compensation awarded, adjudged or paid, be subject to be taken for the debts of the party entitled thereto.

Permission is given by this law for the compromise or settlement of any claim that may arise under the act. In other words, in the event of the agreement of the employer and his injured employee, an anticipatory settlement may be entered into at any time prior to the termination of disability.

In order to collect the compensations due under the compensation features of the law it is necessary for the injured employee to give written notice to his employer within 30 days of the time of the accident.

This is a brief resume of the conditions which surrounded the recovery for occupation injuries prior to the enactment of the Roseberry Law, and also an outline of the principal provisions of that law.

So much for the past and the present; what of the future?

At a special election held October 10, 1911, the people of California adopted the following amendment to the constitution of the State:

The legislature may by appropriate legislation create and enforce a liability on the part of all employers to compensate their employees for any injury incurred by the said employees in the course of their employment, irrespective of the fault of either party. The legislature may provide for the settlement of any disputes arising under the legislation contemplated by this section, by arbitration, or by an industrial accident board, by the courts, or by either, any or all of these agencies, anything in this constitution to the contrary notwithstanding.

Only yesterday I received a circular letter from the Industrial Accident Board, calling attention to the fact that the subject of compulsory compensation for all employers will come before the next Legislature; also inclosing a pamphlet entitled "Memorandum Concerning a Proposed Scale of Compensation Benefits to Be Paid to Workmen Injured Through Industrial Accident."

If the theory upon which compensation for occupation injuries is based, i. e., that each industry should carry its own burdens, is correct—and I believe it is—then it is just and proper that a system of compensation should be calculated to apply to all branches of industries indiscriminately. In other words, compensation should be compulsory. Since, however, the basic principle upon which the theory of compensation rests is to relieve society of the physical derelicts caused through occupational injuries, it should follow that for a simple and temporary injury the compensation should be nil, or, at least, slight, as compared to total permanent disability or death, and no compensation should be paid for disability covering any period of, say, less than 30 days.

Practically all of the European countries, and many of the states of the United States, have enacted laws governing the adoption of safety appliances on all dangerous machinery. California, much to her discredit, has no such law. Our failure to adopt such a law in the face of our having placed a compensation act on our statute books is, to use a rude example, about as consistent as to wear hob-nailed shoes with a dress suit, or the construction of a hospital at the base of a cliff over which we are driving our inhabitants. As a practical expression of what a safety appliance law means I should say that in the State of New Jersey, under a compensation law very similar to that of California, we accept on an average 25 per cent less premium for liability insurance on any given line of industry than that accepted in California, owing to the fact that New Jersey has a strictly enforced safety appliance law, and California has none.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Hydroelectric Development at Verdi 475
Putting It Up to the Man 477
Equalizing of Load Curves 477
The Utility Versus Agricultural Sales 478
By Ross B. Mateer.
Justification of Deviations in Rates for Electric Service.... 479
By S. M. Kennedy.
Form of Cross Sections of Canals 481
By B. A. Etcheverry.
The Public and Public Service Corporations..... 483
By F. K. Blue.
Specific Gravity Determinations 485
By J. P. Zipf.
The Roseberry Law and Workmen's Compensation..... 486
By W. A. Chowen.
Editorial 488
Accident and Pension Funds.
The Demonstration Train.
The Minimum Charge in Arizona.
Notations for Gravity of Oil.
Personals 490
Trade Notes 490
Meeting Notices 491
Industrial 492
A Pacific Coast Insulator Factory.
New Catalogues.
Western Electric Earnings.
News Notes 493
Addenda of 1911 National Electric Code Rules 495
The Necessity for Having a Uniform Standard for Electric Apparatus and Wiring 496
By N. W. Reed.
Requirements for Location of Fuses and Switches on Service Wires 496

No union can ever be lasting wherein each party to the contract does not receive a material benefit.

Accident and Pension Funds

Philosophers may ruminate and social service reformers decry the times, yet the evils to be corrected are only perfectly adjusted by synchronizing the internal attitude of all parties into a harmonious unit rather than attempting to generate a singleness of purpose by methods of enforced tolerance. No truer saying than this can be applied to the fundamental steps necessary in the upbuilding of esprit de corps in the modern public utility company.

The beginning of the new year will witness the putting into effect of the greatest humanitarian movement looking toward material and social betterment of wage-earners ever attempted by a public utility—in fact—by any corporation. Hitherto, previous establishments on a large scale, of funds for accident and pension purposes, have always had some proviso or requirement which many have seen fit to criticize. The United States Steel Corporation, for instance, provides that its employes may buy its preferred and common stock annually below the market price, and pay for it in five yearly installments from wages earned, while effective, nevertheless, some have scented in this an ulterior motive. The scheme of the American Telephone & Telegraph Company, however, strikes boldly and fearlessly into the true concept of old-age pensions and accident funds. This company has made provision for a $10,000,000 pension fund, in which nearly 175,000 workers will participate. Indeed this message carries a new year's benediction from over thirteen thousand Pacific Coast workers. Faithful employes, superannuated in service, may retire on the new pension plan and the untimely accident is to be met by a welcome fund for the helpless dependents or suffering employe.

For all these benefits the employe pays not a cent. This movement of a great corporation is not to be welcomed as that of a philanthropist or of a Daniel, come to judgment. Rather is it the fruits of the foresight and broad-minded business policy of the leaders of a great corporation. Under this new regime, the employe is not to pay the bill nor is the employer, but rightfully is the cost of service to bear the burden of all, that in justice to human rights, it should. Compensation is, first of all, founded in that social justice which demands that each industry shall so take care of its own killed and wounded, and those dependent upon them, that they shall not, as a result of industrial accident, become public charges. But this great movement on the part of the Bell company goes further than merely taking care of the killed and wounded. It proposes to care for those who in the winter of life, as years of faithful devoted service roll by, still remain with us for a season, to live again in thoughtful reflection those years of busy activities in service of the utility.

The great movement in recent years aiming at regulation of public utilities has resulted in a material cutting of former gigantic returns. The cry of the day is to determine the cost of service. The courts have universally recognized the fundamental principles involved in depreciation and obsolescence accounts, and in maintenance and operation of inanimate ma-

chinery. That there is a costly account chargeable to maintenance and operation, due to the human element, is undeniable. Statistics show that industry in the United States kills somewhere between 30,000 and 50,000 persons each year, cripples more or less seriously 500,000 and injures in the neighborhood of 2,000,000 sufficiently to cause them to lose time from work. Again, a necessity for depreciation and obsolescence accounts due to the human factor, though thus far neglected in the expert's inventory of sinking funds, truly exists as a fundamental postulate in order to attain maximum service at minimum cost. For the level-headed farsightedness involved in thus boldly putting into practical operation this humanistic principle, the public stands indebted to the Bell company. This worthy effort deserves the hearty support and communication of all.

The Minimun Charge in Arizona

In the weights and measures law, which was passed by the 1912 legislature of Arizona, it was made unlawful for any company to charge for water, electrical energy, or illuminating gas except by meter measurement, if the consumer request that the same be sold to him by meter measurement.

It is interesting to note how some of the companies have attempted to meet this illogical requirement. The Nogales municipal plant, for instance, has instituted the following complicated and unsatisfactory rate in its water charges:

150 gallons per month at	$ .01	per gallon	$1.50
300 gallons per month at	.00533	per gallon	1.60
500 gallons per month at	.0034	per gallon	1.70
1000 gallons per month at	1.85	per 1000 gallons	1.85
1500 gallons per month at	1.33 1-3	per 1000 gallons	2.00
2000 gallons per month at	1.07½	per 1000 gallons	2.15
2500 gallons per month at	.92	per 1000 gallons	1.30
8000 gallons per month at	.81 2-3	per 1000 gallons	2.45

and so on up to 30,000 gallons.

Such a law as the above is wholly at variance with sound reasoning in rate making. This conclusion has frequently been emphasized in court decisions. That there is a minimum charge, just and reasonable, which bears no relation whatsoever to the power consumed is realized at once when we think of the interest on meters in service, the cost of billing and a score of other costs which must be met whether any current is consumed or not.

That W. P. Geary, the chairman of the Arizona Corporation Commission, states that the law does not meet with the approval of the commission is gratifying. Indeed, the commission itself will exert a powerful influence this winter to properly amend the statutes.

The Demonstration Train

No single factor has added to the general improvement in farming methods of California more than the socalled demonstration train which was operated through the fertile valleys of that state during the past season. This train was the donation of the Southern Pacific Company and was officered throughout by experts from the agricultural department of the University of California. Thousands upon thousands of farmers throughout that great commonwealth thus enjoyed in every village and hamlet served by the railroad, a lecture and demonstration on improved farm methods. Not the least effective was the exhibit donated by the Pacific Gas & Electric Company, setting forth a modern farm irrigated by electrically operated pumps. The other improved methods dependent upon electric power proved also most helpful.

The past week has seen the inauguration at the University of California of a new and enlarged university extension policy in agriculture. Dean Hunt, the newly invested head of this state-wide effort, has every appearance and qualification necessary for the immensely important work ahead. Other commonwealths of the West will do well to emulate the splendid example set by California in thus emphasizing agricultural education, paying particular regard to the effectual work of the demonstration train and its enlightenment as to the superior advantages of up-to-date electrical applications on the farm.

Notations for Gravity of Oil

An instance of ancient fetters still binding the engineer, due to inheritance handed down from unscientific beginnings, is that of the Baume scale generally employed in the gravity notation for crude petroleum. Twaddell's, Beck's and other hydrometers present like conditions. Any notation which states—as does the Baume scale—that for liquids heavier than water one method of computation is to be used, thereby calling for 0 degrees to correspond with unity specific gravity and in the second breath employs a wholly different formula for liquids lighter than water, necessitating 10 degrees to correspond with unity specific gravity, should be tolerated no longer. It is indeed gratifying to note a general tendency in all directions to use only those scales which read in terms of the specific gravity directly.

Inconsistencies, such as this, have been met in the past and swept out of the engineer's routine.

The miner's inch of water, for instance, was a western trouble which caused endless litigation and misunderstanding. This unit has now been satisfactorily adjusted by legally defining it in terms of the more scientific unit, the second foot. While no misunderstanding exists as to an exact relationship connecting the Baume scale with the more scientific specific gravity or water comparison, still the method of juggling is awkward and unjustifiable.

On another page of this issue will be found the method in use whereby the gravity of oil is determined in the laboratory. It will be seen that in an accurate measurement gravity is actually determined according to the natural method and then transformed into the Baume scale by means of the complicated relationship existing for this awkward scale. Like the transformation of one form of energy into another, in this converting of specific gravity into the Baume scale a loss of energy is involved. Energy in the shape of brain tissue and time of the engineer is consumed. Time is money and the thousands of hours lost in yearly transformations, such as this, existing in our engineering routine, cannot but be felt in the ultimate cost of the product. This instance teaches its lesson, and may we not say with truth that the clinging to ancient and cumbersome formulae, when more scientific and accessible expressions exist, adds its quoto to the much discussed topic of the day, "high cost of living."

PERSONALS.

W. W. Hanscom, consulting electrical engineer at San Francisco, is at Los Angeles.

E. N. Fobes, manager of the Fobes Supply Company, of Seattle and Portland, is at San Francisco.

F. A. Richards, manager of the car department of Pierson, Roeding & Company, is in the northwest.

H. R. Noack, president of Pierson, Roeding & Company, has returned to San Francisco from an extended visit to the Northwest.

S. B. Anderson, district manager Pacific States Electric Company, at San Francisco, is spending the week at their Los Angeles office.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, has returned to San Francisco from the East.

A. H. Halloran has been appointed Statesman of the Jovian Order for San Francisco by **Frank E. Watts,** of New York City, Eleventh Jupiter.

H. B. Squires of Otis & Squires is at Los Angeles and San Diego, where he will remain until after the jobbers' convention at Catalina Island.

J. Shaufelberger, storekeeper for the Pacific States Electric Company, at San Francisco, will spend the week visiting their Seattle and Portland houses.

R. H. Marshfield, secretary of the Cutler-Hammer Company of Milwaukee, has returned home after visiting Otis & Squires, Pacific Coast agents for his company.

W. D. A. Ryan, illuminating engineer with the General Electric Company, is at San Francisco to advise on the lighting plans for the Panama-Pacific Exposition.

Alfred Still, chief electrical engineer to the mines department of the Algoma Steel Corporation of Sault Ste. Marie, Ontario, Canada, is a San Francisco visitor.

Rudolph W. Van Norden, consulting engineer, spent the past week inspecting progress on the Pacific Gas & Electric Company's great hydroelectric development at Lake Spalding.

Miles Steel, salesman with the Pacific Coast offices of the Benjamin Electric Company, has returned to San Francisco from a two months' visit to the electrical trade in the Northwest.

E. D. Marx, chairman of the California Water Commission, **J. M. Eshelman,** chairman of the California Railroad Commission, and Commissioner **Max Thelan,** have recently been in Washington, D. C., attending the three day's conference with the Department of the Interior concerning water power and water right legislation.

Glenn C. Webster, who for almost three years has been connected with the National Electric Lamp Association, Cleveland, Ohio, in the official capacity of manager of the engineering department, has recently been chosen as general manager to supervise the activities of the Tungstolier Works of General Electric Company, Conneaut, Ohio. Mr. Webster succeeds **E. J. Kulas,** who has resigned to take up other work.

A. R. Thompson has been made chairman of the recently formed Pacific Gas & Electric Company Section of the National Electric Light Association, **John D. Kuster** being vice-chairman and **H. Bostwick** secretary and treasurer. The executive committee consists of five members, each of whom is chairman of a subsidiary committee, as follows: **S. V. Walton,** papers and meetings; **F. H. Varney,** membership; **C. J. Wilson,** question box; **H. Bostwick,** editorial; **George H. Bragg** and **R. C. Powell.**

TRADE NOTES.

U. S. Electrical Manufacturing Company of Los Angeles report that they have finished the installation of 50 polyphase induction motors in the new Los Angeles Times plant, all of them being slow speed and 35 of the number are 1/3 h.p., 750 r.p.m., 3-phase geared to linotype machines.

The Pacific States Electric Company announce the purchase of the stock and good will of the Holabird Electric Company. The establishment of a store in Seattle completes a chain of houses in all the larger cities of the Pacific Coast, extending from Los Angeles, California, on the south and including San Francisco, Oakland and Portland to the Puget Sound city in the north. It is the aim of the company to carry the most complete stock of electrical goods in the Northwest.

The Union Iron Works of San Francisco have ordered from the General Electric Company a complete converting outfit and motor equipment for their new power house. This includes two 200 kw. 60 cycle rotary converters, one 18-panel switchboard, one 50 kw. motor-generator exciter set, one 165 kw. motor-generator for charging storage batteries, one 150 h.p. motor to operate pump, and 75 small motors ranging from 1 to 35 h.p. The General Electric Company is also installing three 450 h.p. synchronous motors, direct connected to Chicago Pneumatic Tool Compressors.

The Pacific States Electric Company anticipate occupying their new six-story home on Mission street, near Second, San Francisco, by December 23, 1912. The building has been specially designed for the needs of the electrical business, and when completed will be the most modern and completely equipped of any in that line. Pneumatic tube service for the rapid transmission of messages and papers between the various offices has been installed, and prominent among the other features is the provision of a roof garden, where employees may enjoy rest and sunshine during the luncheon hour.

The Pacific Gas & Electric Company has placed orders for the generating equipment of the Drum Power Plant of the Lake Spalding Development. There will be four 17,000 h.p. Pelton-Doble tangential water wheel units, operating under a head of 1375 ft., and each driving a 12,500 k.v.a. Westinghouse alternator at 360 r.p.m. The water wheels will be of the double overhung type, with 85-in. wheel runners mounted on each end of the shaft, between which the rotor will be carried, the three revolving elements being supported by but two bearings on account of the terrific strains involved. The buckets are to be of the patented Doble interlocking chain type, involving some unique principles in design. The nozzles will be of the Pelton-Doble ball joint deflecting type, with counterbalancing mechanism. The wheels will be built in the San Francisco shops of the Pelton Water Wheel Company. The generators will have several novel features of design, and will have a large overload capacity.

MEETING NOTICES.

Jovian Club of San Francisco.

At the regular meeting at Tait's Tuesday, November 26th, P. C. Butte presented a paper on "The Electrical Equipment of a Large Drawbridge."

Portland Jovian Luncheon.

The regular Jovian lunch on November 14th at the Hazelwood was addressed by Will Lipman on the subject of the "Management of a Large Department Store." Mr. Hartley presided as chairman. At the meeting on November 21 Mr. Foshay, business manager of the Portland District of the Northwest Electric Company, outlined their first development on the White Salmon River. He stated that they were installing the largest wood stave pipe in the world, it being 13½ feet in diameter. The initial installation will have

20,000 h.p. in two units, with two Francis turbine waterwheels on each unit. Generator voltage 2300 volts, stepped up to 66,000 volts. The transmission line to Portland will be 65 miles long.

Spokane Jovian Club.

At the luncheon of the Spokane Jovian Club on November 13th the speakers were Mr. Gray, chief engineer, and Mr. Hitt, assistant engineer of the Washington State Public Service Commission. Talks were also given by M. C. Osborn, general commercial agent for the Washington Water Power Company, and Mr. Tompkins of the same company. There were some thirty-two Jovians at this luncheon, a very good attendance considering that the membership is about sixty, and that about half of them are men that spend very little time in Spokane. Any and all Jovians who may at any time be in Spokane are especially welcome at the luncheons, held on the second and fourth Tuesdays in every month. C. R. Bean of John A. Roebling's Sons Company is Statesman.

Seattle Jovian Luncheon.

On November 21 an electrically cooked lunch was served to 125 Seattle Jovians through the courtesy of "The Electric Company" as planned under the direction of Burton R. Stare of the Northwestern Supply Company, chairman for the day. The menu was an elaborate one of ten courses and each separate dish had been prepared on one of the several types of electric stoves that are being shown as a part of the demonstrations of electric cookery by the Puget Sound Traction, Light & Power Company. The luncheon was held at the First avenue offices of the company. Following the luncheon short talks were made by the chairman of the day. Burton R. Stare, of the Northwestern Supply Company; P. J. Aaron, manager of the Western Electric Company; Charles M. Bliven, of the General Electric Company; H. N. Kollock, manager of the Seattle branch of the Westinghouse Company; Morton Ramsdell, sales manager of the Puget Sound Traction, Light & Power Company; James D. Ross, superintendent of the city lighting plant; G. I. Kinney, manager of the San Francisco office of the Fort Wayne Electric Company.

Los Angeles Section A. I. E. E.

The regular monthly meeting of the Los Angeles Section of the American Institute of Electrical Engineers was held in the Blanchard Building at 8 p. m., November 26. F. W. Harris presented an interesting paper on "Oil Switches and Circuit Breakers."

Engineering and Architectural Society of Portland.

The regular Tuesday Engineers' Lunch on November 19th at the Portland Hotel was well attended, the chairman of the day being E. H. West of the Portland Railway, Light & Power Company. The chairman called upon the various members for short stories, which were duly appreciated. The speaker of the day was Gus Roder, superintendent of social service department of the Portland Railway, Light & Power Company.

San Francisco Engineer's Club.

The weekly noonday meeting of the San Francisco Engineer's club was interestingly addressed by H. C. Hoover, E. M., on last Tuesday. The speaker laid special stress on the fact that San Francisco engineers should make every effort to house themselves at once in preparation for receiving the distinguished engineers from all over the world in 1915.

Club Rooms for Oregon Society of Engineers.

Some time ago a committee was appointed by the president of the society, consisting of Wm. S. Turner, P. A. Schuchart, F. A. Naramore and Gordon Kribs, with instructions to confer with other societies in Portland and investigate the advisability of co-operation in the matter of quarters. As a result of their efforts, a joint committee on co-operation was organized, composed of members from the O. S. E.,, A. S. C. E,. A. I. E. E., A. I. A., N. E. L. A. and P. A. Club This joint committee, after much discussion of various plans, decided by unanimous vote to recommend that the proposal of the Portland Architectural Club for the joint use of its club rooms at 247½ Stark street, be made to the Oregon Society of Engineers alone, and if agreeable to it, that it be accepted, omitting for the present to include the other organizations.

As a temporary solution of the matter, in order to get the feature of co-operative club rooms in operation as soon as possible, the arrangement outlined above is satisfactory to all the interested organizations, the plan being to extend the privileges of the club, on suitable terms, to all members of other societies, individually, who desire to enter it. In the meantime, the joint committee is to make a thorough study of the situation and as soon as possible work out a permanent scheme of organization, which will provide for co-operation of all of the societies in other features as well as in the matter of club rooms and luncheons, including also joint meetings for the reading and discussion of professional papers. It is believed that the proposed agreement between the two organizations secures at once for the Oregon Society of Engineers club room facilities which many of the members have desired for a long time, and at a very reasonable cost. It is expected that funds available from present dues will be sufficient to meet the expenses of maintaining the club rooms under the proposed agreement with the P. A. Club, of which the following is a brief outline:

Article 1. Parties to unite in supporting a joint club, to be called The Oregon Technical Club.

Article 2. The government of the said club to be vested in a board of governors of five members, two appointed by each party and the fifth by the four so appointed; said Board to continue in office six months, to elect their own officers and make necessary rules for their own procedure, to be approved by executive boards of each party.

Article 3. The expense of the club to be borne by both parties as determined by board of governors, and to be approved by the executive boards of both parties.

Article 4. The club to take over P. A. Club's lease of rooms at 247½ Stark street, with furniture and fixtures, said P. A. Club retaining the use of the draughting room and its furniture, except when required for meetings of societies, not exceeding six evenings per month without consent.

Article 5. Board of governors may sublet the club rooms for meeting purposes, to other societies, but parties to this agreement shall have free use of same for meeting purposes.

Article 6.—The parties hereto to pay their shares of the expenses of the club, through their own treasurers, monthly.

Article 7. The agreement to be in force for a period of six months from its date, when it shall terminate unless continued in force by agreement, and lease and property returned to respective owners thereof.

This matter is now before the members for ballot.

I. E. S. ILLUMINATION PRIMER.

"Light: Its Use and Misuse," a primer on light and illumination which was published last month by the Illuminating Engineering Society, 29 West Thirty-ninth street, New York, has already gone into a second edition. Written in a clear and comprehensive manner for popular reading, this little pamphlet has met with immediate favor. It has occasioned considerable complimentary criticism from people who are generally supposed to have little or no interest in the subject of lighting. From the heads of engineering and physics departments of schools and colleges the society has received numerous letters of commendation together with requests for quantities of the primer for distribution to students. Architects, engineers, oculists, merchants, and others have also expressed their appreciation of the publication. Several lighting companies are planning to issue it to their customers. One large manufacturing company in London has cabled for permission to print and distribute a large edition in Europe. It is not unlikely that the primer will go into many editions.

INDUSTRIAL

A PACIFIC COAST INSULATOR FACTORY.

Electrical men throughout the country will be interested in the announcement that glass insulators are now being made at Long Beach, California, by the California Glass Insulator Company. This company has completed the installation of the latest and most up-to-date machinery, and commenced operations in October of this year under the experienced management of Robert P. Frist.

The factory is ideally situated within a short distance of Los Angeles on the lines of the Southern Pacific and Pacific Electric Railways. It consists of a large tank house, lehr shed, soda house and mixing shed, machine shop and mould room, store house and packing shed, with separate office. This plant has ten acres of ground with three and one-half acres enclosed.

The manufacture of glass, as is generally known, consists in the fusion of a mixture of silicious sand, sodium carbonate and lime. White sand containing over ninety-five per cent of silica is found in great abundance near Riverside, California, and shipped in sacks to Long Beach, where it is stored in the mixing house. The finest grade of hydrated lime and sodium carbonate are similarly stored here. These ingredients are thoroughly mixed by hand after the proper proportions have been weighed on a most ingenious scale, which is automatically set to determine the proper proportion of each part. The material is then conveyed to the upper end of the longitudinal furnace, which is heated by sixteen especially designed oil burners. The molten mass gradually works its way down to the lower end of the melting tank, passes under a bridge wall to the working end, then is dipped with iron rods through nine apertures.

These rods are handled by men known as gatherers, who pour the molten glass into moulds. These moulds are pressed by a second man, passed on to a third who screws out the pin form, and thence to a fourth who opens the mould, takes out the finished insulators and places them on long trays.

These trays are conveyed to the annealing furnace where they are heated and slowly cooled so as to remove all internal strains from the insulator, the annealing process occupying twenty-four hours. The insulators are then stacked in piles in the open air for three months after which the perfect ones are selected and packed for shipment.

The resulting insulator is as near perfect as the most modern machinery, the greatest care, and the most rigid inspection can accomplish. Standard types are manufactured for telephone, telegraph and power use, and special designs are made in accordance with the customer's specifications.

Arrangements have been made with the Pacific States Electric Company to distribute the products of the California Glass Insulator Company, a full stock now being carried at the Los Angeles, San Francisco, Oakland, Portland and Seattle houses.

The California Glass Insulator Company's Plant at Long Beach, California.

WESTERN ELECTRIC EARNINGS.

With October the Western Electric Company completed the tenth month of its year, and shows a gain in goods billed of approximately 5 per cent over the same period in 1911. Indications are that the year as a whole will show a total of goods billed of slightly in excess of the estimate of $67,000,000 made early in the year. Last year the business done totaled $66,000,000, or within $3,000,000 of the company's largest year, so that this year will show only about $2,000,000 under the record year.

NEW CATALOGUES.

Ralph L. Phelps, Pacific Coast manager for Safety Insulated Wire and Cable Company, is using a neat postcard illustrating two cars of Safety Ruby Core for San Francisco, as an order acknowledgement.

General Electric Catalogue issue No. A4039 is devoted to Direct Current Motor-Starting and Speed-Regulating Rheostats and Panels, and supersedes previous bulletins Nos. 4600, 4559 and 4532, on this subject. No. 4974 illustrates and describes Current-Limiting Reactances designed to be placed in series with generators or transformers, and limit the flow of current in the circuit under short-circuit conditions to values which can be safely withstood by both the generator and transformer. No. 4993 is descriptive of Type RI Single-Phase Motors.

"What We Make" is the title of a compact 48-page book issued by the Green Fuel Economizer Company, of Matteawan, N. Y., describing fuel economizers, both standard and special, coverings for fuel economizers, mechanical draft outfits, heating, ventilating and drying outfits, hot blast heaters, steel plate fans, motor and engine driven fans, cast iron volume blowers, slow speed and standard speed planing mill exhausters, fan and cone wheels, wool wheels, ventilator wheels, propeller fans, vertical and horizontal engines and mechanical draft dampers.

NEWS NOTES

INCORPORATIONS.

BAKERSFIELD, CAL.—Empire Gas & Fuel Company; $100,000, by W. P. Smith of Berkeley, J. W. Reeves and H. B. Ripley of San Francisco.

CALDWELL, IDAHO.—Articles of incorporation of the Beaver River Power Company have been filed here. The principal place of business is Telluride, Colorado.

ILLUMINATION.

KELSO, WASH.—The Oregon-Washington Corporation will build an auxiliary power plant near here.

CAMAS, Wash.—The Northwestern Electric Company proposes to install a complete lighting and power system here.

QUINCY, CAL.—The Indian Valley Electric Light & Power Company has been granted a franchise to erect poles in Plumas county for the transmitting of electricity for light, heat and power purposes.

QUINCY, CAL.—Albert C. Agnew has applied for a franchise to transmit electricity for power, light and heat in the county of Plumas. Bids will be received up to January 9th, for the sale of said franchise.

PRINEVILLE, ORE.—H. V. Gates, owner of the Prineville Light & Water Company, is in the city from Portland for the purpose of turning over the property and franchise of the company to Geo. Jacobs.

SALEM, ORE.—William Hobson, representative of the Hammond Lumber Company, Astoria, has applied for permission to construct a 10,000 h.p. power plant on the north fork of Santiam and Breitenbush rivers.

REDMOND, ORE.—The Prineville Light & Water Company, Prineville, Ore., has secured a contract to furnish lights for Redmond. The company has an option on the Cliff Falls power site and propose to install a water power plant there.

SALMON ARM, B. C.—Weeden & Talbot, New Westminster, have been awarded the general contract for the construction of a municipally owned brick power plant here to cost $3510. DuCane, Dutcher & Company, Vancouver, B. C., consulting engineers.

NEW YORK.—The 11,000 shares of Pacific Gas & Electric Company stock which Samuel Insull announced was sold to a New York interest at $65, was purchased for the Electric Investment Corporation, recently organized by Harrison Williams and associates.

GRANTS PASS, ORE.—The California-Oregon Power Company has asked this city for a 40-year franchise for its power and light system, offering as an inducement 2 per cent of gross revenue in the city and certain concessions in the way of street lights for a period of ten years.

SAN DIEGO, CAL.—A special meeting of the San Diego Consolidated Gas & Electric Company, a subsidiary corporation of the Standard Gas & Electric Company, has been called for December 23d, to vote on the proposed increase of the bonded debt, not to exceed $3,000,000; the new bonds to be issued to discharge floating debt. Bonds are to be payable not later than December, 1922, and to bear interest not to exceed 6 per cent per annum.

LOS ANGELES, CAL.—The Railroad Commission has arranged for a general reduction in electric lighting rates in Southern California, beginning January 1, 1913, covering a large portion of Los Angeles county, San Bernardino county, Riverside county and Orange county. The commission made the investigation upon its own initiative and has reached an adjustment by which the Southern California Edison Company will reduce its maximum charge from 10c per kw.-hr. to 8c. The reduction will effect approximately 27,000 users of electricity and will result in an annual saving, based upon present conditions, of approximately $104,000. Los Angeles and Pasadena are not affected by the order.

TRANSMISSION.

CONCRETE, WASH.—It is reliably reported the Stone & Webster Engineering Corporation has acquired water rights of the Skagit Power Company, Cedar Bar, and will construct a large dam there to develop power.

RANDSBURG, CAL.—Arrangements are being made to equip the King Solomon mine with electric hoisting facilities as soon as the substation of the Southern Sierras Power Company is prepared to furnish power.

CLINE FALLS, ORE.—George Jacobs has petitioned the county commissioners for the privilege to install electric power, utility and private telephone lines in this vicinity. A generating plant will be built at this place.

LONG BEACH, CAL.—Immediate enlargement of the Edison power plant on inner harbor has met with approval of the city, and an order for a third unit of power has been given, making a combined capacity of 64,000 h.p. valued at $3,000,000. Edison officials recently made a trip to study the local plant, and consider how San Pedro service will be affected by the distribution of Owens River aqueduct waters.

LOS ANGELES, CAL.—Negotiations for the purchase by the city of portions of existing power systems for the distribution of aqueduct powers, are being held up until the return of W. B. Cline, head of the Los Angeles Gas & Electric Corporation, who is en route home from Europe. The Southern California Edison Company has practically agreed to sell portions of its system if the Los Angeles Gas & Electric Company will do the same, selling on the same basis.

OROVILLE, CAL.—The Oro Electric Corporation, which is seeking entry in almost every section of the Sacramento and San Joaquin Valleys, is running a power line west from Oroville to the Glenn County line at Butte Creek. This line will cross Butte Creek, which is the boundary line at that point, and will continue to the Sacramento River, a few miles farther west near Princeton, Colusa, Glenn and even some of the coast range counties are stated upon good authority as the next fields that the power is to enter. Two lines are to cross the Feather River below Oroville three miles, and will go due west across the valley floor. A corps of engineers are running a survey from Oroville to the power plant to be built at Humbug. Huge steel poles will be used, and Oroville will be the distributing point.

TRANSPORTATION.

VALE, ORE.—Ladeaux & Ladeaux, contractors, 189 Simpson street, Portland, have been awarded the contract for building a car repair shop 35x135 feet here for the Oregon Electric Railway Company.

STOCKTON, CAL.—The Stockton Electric Railroad Company has made application for a franchise to operate an electric railroad in certain streets of the city. Sealed bids will be received up to December 9.

KALISPELL, MONT.—Robert P. Austin, Walter H. Griffin and Robert J. Benn have incorporated to own and operate the Flathead Valley Interurban Railway from this city to Whitefish, Somers and Bigfork. The company is incorporated at $50,000.

EDMONTON, ALTA.—Arthur G. Harrison, member of the Board of City Commissioners, is authority for the statement that $1,500,000 will be expended by the municipality for street railway construction, rolling stock and substations during the coming year.

SAN FRANCISCO, CAL.—Mayor Rolph and William H. Abbott, chief council for the United Railroads, have signed the agreement between the city and the United Railroads concerning the use of the Market street outer tracks and the interchange of transfers between the Geary street line and the lines of the company.

SEATTLE, WASH.—E. M. Mills, representing Peabody, Houghteling & Company, bondholders of the Seattle, Renton & Southern Street Railway Company, announces that seven miles of railway will be built by the concern as soon as some slight difficulties can be overcome. The matter rests in the hands of the city council and voters.

LOS ANGELES, CAL.—Bids will be received up to December 2nd for the surrender of bonds of the Pacific Electric Railway Company, dated March 12, 1902, deed of trust given to the Union Trust Company of San Francisco. Bids should be endorsed "Bid for surrender of Pacific Electric Railway Company 5 per cent bonds, due January 1, 1942."

SALT LAKE CITY, UTAH.—The Salt Lake & Ogden Railway has been sold by Senator Simon Bamberger to M. B. Hereley of Chicago, who represents Eastern capitalists. The Electric line from Salt Lake to Ogden will be the nucleus of an electric interurban system, financed largely by Eastern capital to run throughout the State. Mr. Hereley's plans include the immediate purchase of the electric line from Ogden to Logan and the proposed electric line from Salt Lake to Payson.

MERIDIAN, CAL.—The freight and passenger trains of the Northern Electric Company are now running into Meridian again from Marysville, over the Butte Slough bridge, it having been completed. This is claimed to be the most expensive steel trestle in the country. It crosses Butte Slough and is 2600 feet long. In Meridian the company is completing its grades leading to its Sacramento River bridge. Concrete bulkheads are placed at each street crossing and the streets run under the tracks. The road will be in operation between here and Colusa next spring.

STOCKTON, CAL.—The San Joaquin Valley Railroad Company is to be merged with the Modesto & Empire Traction Company. This is the result of a recent meeting of the directors of the power company. All that remains is the formation of the new company and election of officers, subject to approval of the Railroad Commission. It is understood that the new corporation will be known as the San Joaquin Valley Company. It is the intention to capitalize for $1,500,000 and stockholders in the two old companies will be given stock in the new one in exchange for their present holdings.

VALLEJO, CAL.—The Vallejo & Northern Railroad Company has asked the Railroad Commission to investigate and determine whether the railroad, together with its branch and trunk lines from Boynton to Armijo and from a point on the main line near the town of Fairfield to Fairfield Junction, all in Solano county, yields sufficient income to defray the expense of maintenance and operation. Only a short time ago the Northern Electric Company obtained permission from the Railroad Commission to purchase the stock and holdings of the Vallejo & Northern, intending to use the line for a continuation of its own from Sacramento to tidewater and to establish connections at Vallejo for San Francisco by a new ferry service. The controlling carrier may seek to discontinue the operation of the Vallejo & Northern until its connection with Sacramento is established.

SACRAMENTO, CAL.—Construction of the Northern Electric's extension from Sacramento to Vallejo was made possible when the Railroad Commission authorized a bond issue of $10,000,000, most of which will be applied on the construction of a Sacramento-Vallejo line. Assurance is given by the company that the extension will be completed in 1913. The road will operate in connection with boats between Vallejo and San Francisco, which will make the time between Sacramento and San Francisco two hours and 45 minutes. There will also be branches to Suisun and Vacaville. The railroad company last week was given possession of the Reed orchard property in Yolo county opposite Sacramento after several years of litigation and will begin work next week grading across the property and filling the waterfront. Permission was obtained from the War Department for the construction of the first section of the wharves at that point. At Vallejo the other terminus of the new construction, the work is now within about six weeks of completion. As soon as spring arrives work will be rushed at different points along the line, so that the extension can be placed in operation at the earliest possible moment.

TELEPHONE AND TELEGRAPH.

DAYTON, ORE.—The Pati Telephone Company, recently organized, will build about 50 miles of line. Thomas Reed, president.

LAKEPORT, CAL.—A franchise to erect poles and string wires on Main street and other streets of the town, has been awarded to the Lake County Farmers' Telephone Association

CONCRETE, WASH.—A telephone line will be extended from Baker River ranger station to the government hatchery, Baker lake. Jesse M. Mann, forest ranger, will supervise the work.

DAVENPORT, WASH.—The Local and Long Distance Telephone Company's line and all its appurtenances were sold at a mortgage sale in this city, to the Washington Trust Company of Spokane.

METROPOLIS, NEV.—C. G. Winter, representing the Nevada & Idaho Telephone & Telegraph Company, has asked for a franchise which will permit them to establish a line in Elko county, through Metropolis from Wells, to Twin Falls, Idaho.

PORTLAND, ORE.—Announcement has been made that the Pacific Telephone & Telegraph Company has bought a tract of land 50 by 200 feet, upon which a new branch telephone exchange building will be erected as soon as plans and specifications can be prepared.

LANGTRY, TEX.—Geo. Coots, with a crew of men, has started work on the construction of a telephone line from Langtry to Pumpville, a distance of 12 miles. This is an extension to the Del Rio, Comstock, Langtry line, and will be pushed on to Sanderson in the near future.

LOS ANGELES, CAL.—The Title Insurance & Trust Company, J. F. Jack trust officer, desires to purchase first and refunding mortgage gold bonds of issue of Home Telephone & Telegraph Company of Los Angeles, dated July 1, to amount not exceeding $45,020. Submit offers in writing not later than December 10.

LOS ANGELES, CAL.—The franchises of a telegraph company, giving it the right to operate in the state, are assessable in California as taxable property, according to a decision rendered by the State Supreme Court. The Postal Telegraph Company brought suit in Los Angeles county to recover $625 in taxes, paid under protest. The sum was assessed upon its right to operate in Los Angeles. The company won its suit in the lower court on the grounds that it was operating a Federal franchise granted under an act of Congress and that a tax for a franchise to operate within the State was unconstitutional. The Supreme Court, however, ruled that a Federal franchise does not necessarily give unincumbered right to occupy state highways and reversed the lower court's decision with a closing sentence to the effect that the right to operate on highways within the state is assessable.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

ADDENDA OF 1911 NATIONAL ELECTRIC CODE RULES.

Underwriters' Equitable Rating Bureau, Portland, Oregon, November 1, 1912.

(Concluded.)

Rule 38. **Moving Picture Establishment Wiring.**—Special rulings published in this journal November 9 and November 16, 1912.

Moving picture machines and stereopticons installed in buildings other than theatres must be wired for a capacity of 46 amperes per arc, operated in parallel. Each machine must be controlled by a 2-pole switch and cutout, and the arc machine, if portable, must be connected up with an approved theatre plug.

Rule 45c. **Oil Transformers.**—In order to obtain the required approval of the Inspection Department, transformers must be safeguarded by resting on concrete of at least three (3) inches in depth; be placed immediately under the sidewalk in an enclosure, which must be ventilated by an opening at least six (6) inches square through the sidewalk or to a chimney or flue; the fire-resisting material used in constructing the enclosure in which the transformer is located, and by which it is effectually cut off from the remaining part of the basement, must consist of a brick or concrete wall at least eight (8) inches in thickness, access to which must be by an approved fire door. The transformer room so constructed must be supplied with sill, to prevent the flow of oil into the basement in case of explosion.

As an alternative to the above construction, the transformer may be placed in a tight steel tank, ventilated to the street and standing on concrete.

Any special transformer installations should be taken up with the Inspection Department.

Rule 50. **Rubber-Covered Wire,**

Rule 54. **Flexible Cord,**

Rule 55. **Fixture Wire,** and

Rule 57. **Armored Cable.**

In March, 1911, the specifications for rubber-covered wire were changed by the Underwriters. This necessitated the change in the color and form of the labels, which will be attached to the coils of inspected wire. (See pages 11 and 101 to 107, April, 1912, List of Electrical Fittings.)

After January 1, 1913, the use of wire made under the old specifications will not be sanctioned by this office. Consequently all contractors and supply houses who have a stock of old wire on hand for use in this territory will kindly govern themselves accordingly.

Rule 59. **Junction or Pull Boxes in Connection with Switchboards.**—The tendency of late in this territory, in a great many installations, has been to build immense junction or pull boxes at the rear of switchboards, and allow the wires to enter same from the building in conduit or knob and tube work and be distributed to their proper locations on switchboard or meterboard from the bottom or top of this junction or pull box as the conditions may demand—the wires inside the junction or pull box crossing and recrossing and lying together in a most hazardous manner.

We feel that this is not consistent with the best methods of installation, and that we are inviting trouble of a serious nature. Therefore, in the future kindly refrain from this practice, and if a junction or pull box of this character is used, we will expect all wires to be cabled and racked up in an approved method inside of same.

All installations of this character should be taken up with this bureau before work is commenced.

Rule 62e. **Cleats.**—This department will not pass a 3-wire cleat on a 3-wire system. The wires must be spaced 2½ inches apart on voltages 0 to 300, and 4 inches apart on 301 to 550.

Rule 65j to k. **Switches.**—See pages 3 to 5, April, 1912, List of Approved Electrical Fittings.

Rule 67. When cutouts are of single-pole type and not mounted in connection with switches, they are not interchangeable on any current capacity whatsoever. Consequently when it is desired to use cutouts on voltages from 251 to 600 volts A. C. or D. C., use the proper voltage rating corresponding to the system on which they are to be used.

Rule 70. **Steel or Iron Cabinets.**—After November 15, 1912, this bureau will not sanction the installation of any steel or iron cabinets except those bearing the Underwriters' Label or those approved by them. (See April, 1912, List of Approved Electrical Fittings.) This list is revised every six months, consequently it may not be complete; therefore it will be necessary to take up specific instances with the bureau direct.

We beg to call to your attention that "Steel or Iron Cabinets" are required by the National Electric Code in mixed "knob and tube" and "conduit" installations; also that "Steel or Iron Cabinets" **may be** used with "knob and tube" work.

Note that this does not apply to wooden cabinets.

Rule 83, Div. (b). **Electric Signs.**—From this date on this department will consider all wiring of Sign Structures located any place whatsoever—except on open ground—subject to mechanical injury; and same must be encased in approved rigid or flexible iron conduit.

Also, when conduit is used, Standard Cabinets must be used in accordance with Rule 70, N. E. C., instead of cabinet specified in third paragraph of Rule 83, Div. (b).

All sign circuits must be wired 2-wire.

Electrical Installations in Special Hazards.—Woodworking plants, manufacturing plants, mining plants, packing houses, warehouses, canneries, etc. Pamphlet issued on this class of installations.

Fire Alarm Systems.—Must in all cases be taken up with Inspection Department.

Electrical Fire Pumps.—Separate pamphlet issued by National Fire Protection Association. Can be obtained at the office of the Underwriters' Equitable Rating Bureau.

Service Feeders and Subfeeders for Lighting Systems and Heating Systems.—Sufficient capacity must be installed in all cases so as to furnish 3 amperes per circuit for 3-wire service and 6 amperes per circuit for a 2-wire service. Any deviations from this must be sanctioned by the Inspection Department in writing.

Service Feeders and Subfeeders for Power.—Same must be installed according to publication on D. C. and A. C. motors. When power installations are of an extensive character with a great number of motors, the "load factor" will be considered, and same should be taken up with the Inspection Department.

Paper and Cambric Insulated Lead-Sheathed Cables.—This department will not sanction in future the installation of paper or cambric insulated lead-sheathed cables in any buildings, either open, in open conduit or under the basement floor.

The paper and cambric insulated cable must end at the curb line; and rubber-insulated, braid-covered or lead-sheathed cables must be used inside all buildings.

Nothing except approved conduit must be installed inside buildings or under basement floors.

Metal Gutters.—So as to improve the workmanship and obtain safer condition when metal gutters are substituted for iron conduits, we will specify the following conditions, which must be complied with in the manufacture of these gutters. Also, we find that they have not been thoroughly satisfactory

in the past—giving considerable trouble from short circuits, etc., due to the fact that proper judgment has not been exercised in the number and size of wires installed in same:

1st. No metal gutter will be passed which is of larger cross section than fifty (50) square inches.

2nd. All metal gutters must be made with wall thicknesses and covers equivalent to iron conduit thicknesses. This thickness to be governed by the cross section of the gutter, using the corresponding pipe thickness for equivalent cross section. List of these thicknesses can be found in the Table of Conduit Sizes in the pamphlet published by this office, entitled "Wiring Data for Direct and Alternating Current Motors."

3rd. All covers must lap over the side walls of the trough and must be secured substantially in place.

4th. The number of circuits and wires must be limited to four 2-wire circuits and three 3-wire circuits in any one gutter.

5th. Partitions in gutters will not be acceptable; that is, a partition in a gutter with a common cover extending over same and fastening to the outer walls, will not be considered as two gutters. Each gutter must be built separately by itself.

6th. Gutters may be built of small size if wires in same do not exceed No. 12 B. & S. gauge; no gutter to be built of less than No. 14 U. S. gauge steel. Not more than twelve (12) wires will be allowed in any one (1) of these gutters.

THE NECESSITY FOR HAVING A UNIFORM STANDARD FOR ELECTRIC APPARATUS AND WIRING.[1]

BY N. W. REED.

Electrical contractors, when installing electric work, and supply houses, when selling appliances, would be greatly benefited if a uniform standard existed for these installations and devices. But this standard should also be satisfactory to other associations or parties, such as owners, power companies and insurance companies. With uniform requirements the work of an inspector would be very much easier, for one of his most unpleasant duties is to settle differences of opinion between an owner and some electrician, when each has a different standard. In such a case the owner and electrician are as nearly at right angles as the phases of a two-phase current, and the inspector's third standard will only change things into a three-phase, star-connected system until some one becomes the grounded neutral; and even then the work is not always satisfactory.

Property owners call upon inspectors more frequently than ever before to inspect work which has been done by contract; and not only do they wish to know if it has been properly done, but also if it is in compliance with the standards of other inspection departments. Of course, this makes it most important that there should be a uniformity of requirements among inspection departments, as varying standards will only add to the confusion. Furthermore, such uniformity will not only obtain better results from the electrical appliances and a great saving of material, but it will also reduce the possibility of fire loss.

One of the most important items to be considered by a property owner in planning a building is the danger from of fire to either building or contents. If the builder is going to consider this hazard, the manufacturers of electrical appliances and the electricians installing the devices must take into consideration the possibility of a fire being caused by electric current. Electric power has developed to such an extent that within a very few years it will be used almost entirely for lighting of buildings, driving machines in factories, heating devices of all sorts, such as irons, boilers, stoves and similar appliances. Therefore, it is becoming more important than it was a few years ago that every possible precaution be taken to decrease defects in electrical apparatus, and to have the wiring properly installed. Most electrical fires are caused by neglect, recklessness or ignorance on the part of some one making changes or additions after the first installation; and a simple method of decreasing this hazard is to encourage a sufficient number of lights, make provision for heating and other devices which may be added at a future time, and have receptacles for attachment plugs where connections can easily and safely be made.

Uniformity of standards can be attained only by the cooperation of electrical, insurance, architectural and other organizations, and should not be left to any one body. The Underwriters' Laboratories at Chicago have made tests and examinations of electrical appliances and if, in their opinion, the device is in accordance with the Code, it is labeled so it can be identified after installation, or else listed as a "Code Standard."

[1]Presented before San Francisco Jovian Club, November 19, 1912.

REQUIREMENTS FOR LOCATION OF FUSES AND SWITCHES ON SERVICE WIRES.

Section 23a, under the general heading Constant-Potential Systems, "Automatic Cut-Outs (fuses and circuit-breakers)" of the National Electrical Code for 1911, reads as follows:

(Automatic cut-outs, fuses and circuit-breakers) "must be placed on all service wires, either overhead or underground, in the nearest accessible place to the point where they enter the building and inside the walls, and arranged to cut off the entire current from the building."

Section 24a, under the same general heading, but referring to "Switches," reads as follows:

(Switches) "must be placed on all service wires, either overhead or underground, in the nearest readily accessible place to the point where the wires enter the building, and arranged to cut off the entire current."

To comply with these requirements, all electrical work must be installed in accordance with the following general understanding of these two sections, which together refer to the location and character of fuses and switches for service wires:

First: The fuses and switch for any service may be installed in separate locations, but both the fuses and switch must be within reach.

Second: When a service enters the basement of a building from underground systems, fuses must be placed where the service wires first pass through the wall of the building, or, if the space under the sidewalk is excavated, such fuses must be placed where the service wires first pass through the bulkhead under the sidewalk.

Third: Where service wires from overhead lines enter a building in conduit, the main fuses must be located just inside the wall of the building at the point where the conduit first enters the building. The main fuses must be placed in an approved iron cabinet, unless the meter cabinet is at the same location, and the fuses and switch placed inside the meter cabinet. The conduit leading from the service hood outside the buildng to the main fuses must not be concealed in the walls of buildings, but such conduit must be run exposed on the outside of the buildings to a point opposite the location of the main fuses. Under no circumstances may the length of this exposed conduit on the exterior of a building exceed thirty (30) feet. See list of electrical fittings for approved service hoods.

Fourth: All fuses protecting service wires must not exceed the allowable capacities of wires as set forth in Section 18 of the "National Electrical Code."

Fifth: When two or more wires are run in "parallel" as is sometimes done for services of large capacity, each wire must be protected by a fuse, so that the allowable carrying capacity of each wire cannot be exceeded.

BOARD OF FIRE COMMISSIONERS OF THE PACIFIC.
San Francisco, Cal., November 15, 1912.